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Technology in the Geometry Room

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by

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<u>Chapter 1: Introduction</u>

I was introduced to the SMART Board in January of 2008. I stepped into my second student teaching placement and there was only a SMART Board and projector: no overhead, blackboard, or dry ease board. I was terrified; my favorite piece of technology was the over head projector and there was not one available. I was forced to learn how to use the SMART Board and now I believe it is the best piece of technology for instructing mathematics. Today, I would never go back to teaching with an overhead projector because of all the educational benefits to using a SMART Board.

According to the SMART Technologies home page (*Beginnings of an Industry* 2010), the SMART Board was developed in 1991 by Smart Technologies. The company SMART Technologies was having trouble at first marking their product, The SMART Board. In 1992 SMART Technologies turned to Intel Corporations to help with marketing. The SMART Board was the first interactive whiteboard to provide touch control of computer applications and annotation over standard Microsoft Windows applications (*Beginnings of an Industry* 2010). The SMART Board was first found in classrooms, presentations, and group meetings.

There are two products that go with the SMART Board that I would like to learn about and get for my classroom in the future, SMART Sympodium and the Senteo student response system. In 2002, the SMART Sympodium was introduced (*20+ Years of Innovation* (2010). The SMART Sympodium must be hooked up to a

SMART Board. The SMART Sympodium allows you to write while facing your audience. The best way I can describe a SMART Sympodium is to say it is like writing on a clip board, while everything you write is then appearing on the SMAR Board. In 2007, SMART Technologies introduced the Senteo student response system (*20+ Years of Innovation* (2010). "The system includes a handheld device for each student in a classroom and a central receiver that allows teachers to send information out to each device and receive information back from each student. The system increases one-to-one interaction by allowing teachers to survey and engage students and collect responses to personalize the learning environment" (*20+ Years of Innovation* (2010).

Every SMART Board must have a projector and a computer hooked up to it. When the SMART Board is on it is an interactive touch screen. The screen can be touched by a persons hand, pen (only a Smart Board pen), or another object that contains no real ink. The SMART Board is equipped with four interactive pens and one eraser, which are extremely useful. For example, if a student is having trouble seeing the board you can enlarge the text by making a rectangle with an interactive pen. Also, you can make a circle with the interactive pen and it will make a spot light around what you are trying to highlight. The eraser is very useful for a teacher when you teach back-to-back classes. I remember scrambling to get my overhead sheets cleaned off in between classes; the interactive eraser erases worksheets in seconds.

There are many other features to the SMART Board that are beneficial to the entire educational processes. Being a teacher in the Rochester City School District attendance is a daily issue in my classroom. Having a SMART Board makes the attendance issue not as big of a problem because of its ability to save and record lessons. After I have taught a lesson I can save and record exactly what we did for that class period and print it for the absent students. A teacher said in a research article, "Whenever I want to refer to a concept, image or content from earlier in the year that will reinforce what the class is currently doing, I can call it up instantly" (Kealey, 2010). Many of my students require assistance during my SMART Board presentations. The drag and revel features allow me to walk around the classroom to provide assistance because my entire notes can be pre-loaded on the SMART Board and I can reveal sections of the notes at a time by one simple click. The fact that the white boards are interactive allows the teacher or students to open educational interactive website and software that the entire class can view. I enjoy opening Geometer's Sketchpad in my classroom through the SMART Board.

In the past decade, from my personal experiences there has been a tremendous increase in technology use in the mathematics classroom. The use of technology in mathematics instructions has been recommended by the National Council of Teacher of Mathematics (NCTM, 2000). I have observed mathematics classrooms that use different types of projection software, educational software, and graphing calculator software. In this thesis I am going attempt to investigate the effects on student learning when a SMART Board interactive whiteboard and other mathematical technology is used in the secondary mathematics classroom. The research conducted by Shenton and Pagett (2007) reported on what many teachers and students thought was the greatest impact of the interactive white board (IWB). Students increased the number of vocabulary words learned when their teacher used a SMART Board in the classroom (Mechling, Gast, & Krupa, 2007).

In the new New York State mathematics curriculum there is a strong emphasis on vocabulary. Students increased their understanding of vocabulary words when they were able to interact with to the SMART Board (Campbell, M. L., & Me, L. C., 2009). Since the research is very limited on SMART Technology products, I looked into the effects on student learning when mathematical video games, mathematical computer programs, and motivation strategies were used in the mathematics classroom. A program that can be run through a computer is compatible with a SMART Board.

Mathematical video games showed students how to learn mathematics in a different way and make class time seem fun and interesting (Kebritchi, M., Hirumi, A., & Bai, H., 2010). As reported by four classrooms teachers, students benefitted greatly when they used geometry computer programs Geometer's Sketchpad, Carbi Geometry, and Geometry Supposer (Hennessy, Deaney, & Ruthven, 2008). When students used those computer programs they learned how to investigate, experiment, and explore geometry concepts. There was also an increase in student learning and achievement when they used computer-supported homework (Mendicino, Razzaq, & Heffernan, 2009). When students felt highly motivated in mathematics class they would use appropriate help-seeking strategies when working on problems through a technology software program for geometry instruction, therefore their achievement went up on the given task (Gross, 2004).

I was very quick to embrace the Smart Board because of all student and teacher benefits. For the students, I observed the positive affects on classroom environment and students attitudes toward mathematics. For the teachers, I observed happiness when teaching and them to be more flexible to answering student's mathematical questions. I believe there is a need for research to see if the IWB and other mathematical technology programs have an effect on student performance. This study is going to attempt to investigate the effects on student learning when a SMART Board IWB and other technology programs are used in the secondary mathematics classroom versus a traditional blackboard or white board.

Research Question

This study I am going to investigate the following research questions:

1. Does the use of technology in a mathematics classroom result in better student performance?
2. Do students feel more motivated to do better in mathematics class when technology is used in the classroom?
3. Do students have positive attitudes and perceptions towards mathematics class when technology is used in the classroom?

Significance

This study focuses on the connections between enhanced technology in the geometry classroom to student performance and students' perceptions toward attitudes and motivation in the mathematics classroom. This study is about two high school mathematics classes that use enhanced technology for a unit. This study focuses on SMART Boards, geometry computer programs, and educational web sites as the enhanced technology. The purpose of this study is to find a relationship between enhanced technologies and student performance and students' perceptions toward attitudes and motivation in the mathematics classroom.

Terms

There are many SMART Board terms and tools that I will be using throughout this study. These are my definitions of what these terms and tools do and mean to me:

- A SMART Notebook file is like a PowerPoint presentation file. A SMART Notebook file can be very interactive and engaging. This is where I create all of my lesson presentations.
- A SMARTView TI-89 Graphing Calculator is interactive graphing calculator. This is one of my favorite aspects about the SMART Board because students can see their exact calculator on the board. I find this calculator to be extremely beneficial when teaching Trigonometry because of all the switching modes and graphing in questions. This tool is essential because of my big class sizes. I have

29 students in every class and I cannot imagine walking around to check on every student's calculator for every step.

Chapter 2: Literature Review

SMART Board

SMART Boards have found their way into many classrooms around the world (Shenton & Pagett, 2007). I have used a SMART Board in my classroom for three school years and it is my favorite part of my classroom. Information can be efficiently and effectively presented through a SMART Board, which has allowed computer presentations of information that feature animations, sounds, and interaction to be seen by students around the world (Campbell & Me, 2009). Shenton and Pagett (2007) addressed very informative research questions about IWB. They found that most teachers who use the IWB to make pre-made notes, use multimodal texts, and give assessments. Next, the study found that different schools supported and resourced the IWB in different ways; some sent their teachers to in-service training and others received only a brief overview. The study shared many different teacher responses on how the IWB has impacted their classroom practice. Teachers stated that the IWB has allowed them to experiment, become more flexible, use more resources, and use less paper. In essence, the IWB has changed their teaching style completely. It was extremely interesting to me to read the results about where the students thought the IWB impacted them the most. I was excited to read that many students referred to the interactive protractor from their math class as having the most educational impact on them. The students reported in their interview that watching the math tools, the ruler, and the shapes move had a positive impact on them (Shenton & Pagett, 2007).

There are many vocabulary words and concepts in the New York State mathematics high school curriculum. Campbell and Me (2009) researched students' learning and understanding of vocabulary words when the information was presented to them through computer-assisted instruction with a SMART Board. All participants showed a significant increase in learning and understanding of their vocabulary words when they received instruction through the SMART Board. These participants were able to master vocabulary due to the interactive features of a SMART Board.

Mechling, Gast, and Krupa (2007) also based their research on the impact of SMART Board technologies on students' vocabulary mastery and retention. The authors reported that the size of the SMART Board versus the size of a traditional computer screen supported delivery of the target information and student learning by making the images much larger and increasing attention to the task (Mechling, Gast, & Krupa, 2007). The study found there to be an increase in correctly matched target words when using SMART Board technologies. The entire classroom learned other students' target words from watching each student go up to the SMART Board and match words.

A recent qualitative and quantitative study looked into the extent to which the use of the IWB was associated with student's self reported level of motivation in mathematics (Torff, B., & Tirotta, R. 2010). These authors stated that they believe IWB technological capabilities and its attendant software are highly compelling to students and effectively drawing them into the content of the lesson (Torff, B., & Tirotta, R. 2010). This study took place over one school year in the academic subject area of mathematics. This school district made a strong commitment to IWB technology. I believe the research question for this study is: To what extent is the use of IWB associated with student's self-reported level of motivation in mathematics? There were two groups of students, one group that is exposed to an IWB and the other group that is not exposed to IWB during mathematics instruction. There were 773 students and 32 teachers participating. The study used descriptive statistics using means, standard deviations, minimums, and maximums. Also, the study created two surveys, one for the students to self-report motivation and the other to assess teachers' attitudes toward IWB. The study found mixed results. The students who were exposed to the IWB during their mathematics instruction reported a slightly higher level of engagement in classes. The teachers' attitudes were slightly associated with levels of motivation in their students: in others words if a teacher used and supported IWB their students would be more likely to feel motivated by the IWB (Torff, B., & Tirotta, R. 2010). I completely agree with the authors when they stated, "Investment of financial and human resources in IWB technology is seen as warranted in part because it promises to making learning more engaging for students, especially in technical subjects (e.g. mathematics) in which teachers sometimes struggle in their efforts to help students engage and achieve" (Torff, B., & Tirotta, R. 2010). This study feels there needs to be more research on the academic outcomes from using IWB.

It is extremely interesting to read about research done by other teachers in the education field about SMART Boards. There are many benefits to the SMART Board that I do not initially think about because the SMART Board has been a part of almost my entire teaching career. While reading research journals and articles I came across an article by a teacher who had a different way that the SMART Board enhanced his students learning. In this study the teacher found there to be a benefit in the size of the SMART Board. The SMART Board screen is 77 cm where classroom television screens are typically 28 cm (Kealey, 2010). This study discusses the Screen Capture toolbar and the sound capabilities. In my own classroom I use the Screen Capture toolbar every day. The Screen Capture tool allows the teacher or student to take a 'picture' of anything that is on the computer screen and place it in a SMART Notebook file. For example, if I am using the SMARTView TI-89 Graphing Calculator in my lesson, I can take a picture of each step and put it in my presentation. This is beneficial because now I can save a new lesson file with additional information in it. This Screen capture tool makes me feel that I am actually improving my lesson plan while I am teaching. This study discusses how you can export your SMART Notebook file to become a PDF file. This author says that he exports his file as a PDF and puts them on the school's intranet (the default page that comes up when you turn on the Internet) for students to access later in the school year (Kealey, 2010). This author enjoys how at any moment you can turn a teacher-directed lesson into a student-directed lesson by having the students come up to the board and 'have a go' in front of the entire class (Kealey, 2010). This teacher purchased a wireless keyboard and mouse that went with the SMART Board. This teacher passes around the key board to every student during class and has them contribute to the SMART Board presentation (Kealey, 2010). This article gave me many ideas for enhancing my lessons and gave me ideas for different pieces of technological equipment that I can put in for through grant money.

Mathematical Video Games

Playing video games is common for students, especially outside of school (Houssart & Sams, 1998). Houssart and Sams (1998) found when the students in their research study played mathematical video games they were learning and using mathematical language and gaining mathematical reasoning skills. In order for students to be successful in this particular video game, students had to be able to think past the game and use their mathematical knowledge that they had learned in class. Dialogue showed students seemed to be focused more in class because they knew they would need to use the material in order to be successful in the mathematical video game.

"Traditional mathematics classroom teachers are faced with the challenge of delivering instruction that competes with the media-rich and interactive experiences the typical student is exposed to daily" (Gillispie, Martin, & Parker, 2010 p. 1933). Computer-based mathematical video games and interactive math web sites can be played through a SMART Board. A recent study by Gillispie, Martin, & Parker

(2010) researched the effect of mathematical video games on students' achievement and attitudes toward mathematics. The pre-test and post-test results showed achievement gains for many mathematical algebra concepts. The results from the observations showed that understanding mathematical concepts occurs when participating in mathematical video games. The student interviews resulted in numerous positive responses about the game as a learning tool. For example, the students wanted to advance in the mathematics video game, therefore they needed to learn the mathematical concepts in class.

Other research has explored the achievement and motivation of students who get to play mathematical video games versus student who do not receive access to the games (Kebritchi, Hirumi, & Bai, 2010). In summary, there was a significant improvement of the achievement of the experimental group versus the control group. While there was no significant improvement in the motivation of the students in either group, the students who used the computer games reported greater motivation at the time of their interviews. Achievement and motivation of the experimental group was not significantly impacted by prior knowledge, computer knowledge, and their mastery of the English language. They were impacted by the concept of the game. Teachers reported in interviews that students were happy to put their paper and pencils away; this will be a means to teach mathematics in the future. Students who participated in mathematic video games seemed more interested in mathematics class and became more aware of connections between mathematics and the real world. Finally, students retained mathematical ideas longer because they knew they needed to use these concepts throughout the video game to achieve success. These mathematical video games can be played as a class or individually through a SMART Board.

Mathematical Computer Programs

There are many different computer software programs that are compatible with SMART Board. The SMART Board can make it easier for teachers to use mathematical software in their classroom because the students can see exactly what the teacher is doing while they are at their own computers. The research conducted by Hennessy, Deaney, and Ruthven (2008) examined the flexibility of geometry educational software in classroom practice. The study introduced Geometers Sketchpad (GSP), Cabri Geometry, and Geometry Supposer, student interactive computer software mathematics programs. The following four classrooms summarize the author's observations: Teacher N used the geometry technology to show and model the concept that was being taught to the students. Teacher P1 structured a student-centered activity for students to use the technology program to support a mathematical principle. Teacher P2 structured an activity where students would use a customized figure to use as a reference model. Teacher Q made a worksheet where students simply follow the directions and record their findings.

Teacher N had a 10^{th} grade geometry class. In an interview this teacher said that the lesson went smooth because they created the figure before class time. The teacher reported that they would not have students at this level create this figure on their own in Cabri because there is not enough time in the curriculum for students to learn a new computer program. This teacher stated that the students would make errors and many timely mistakes and the return from the time invested was minimal. According to this teacher this particular 10th grade geometry curriculum did not require any degree of investigation; this class only needed to know basic geometric facts which could be accomplished without the use of geometry software.

Teacher P1 had a 7th grade class. This teacher conducted an in class example on the IWB of what students would be creating in the computer lab. Since the students saw exactly what to do on the IWB they were more prepared to complete their task in the computer lab independently. This teacher reported the time spent learning the program was time well spent.

Teacher P2 had a class of 11th graders that was working on geometry and trigonometry material. According to the interview questions and answers that are shown in this study, this teacher did not say if it was worth the time invested, yet the students benefited greatly.

Teacher Q had a 7th grade class working on triangle bisectors. This teacher found it to be important to have students exploring and discovering abstract geometry thoughts. Hennessy, Deaney, and Ruthven (2008) found that geometry teachers use geometry software technology as means of supplements to their curriculum. The authors of another recent study found when using *Dimension-M* (a mathematical video game) as a supplement to classroom instruction there were gains in student achievement (Gillispie, Martin, & Parker, 2010). Finally, the authors observed in most classrooms that the technology was being used for investigations, experimentations, and student exploration.

Another recent study researched mathematic computer programs, but this study focused on math homework. This study found that students learned significantly more when using the technology web-based homework versus the traditional paper-pencil homework (Mendicino, Razzaq, & Heffernan, 2009). The authors believed that students took the web-based homework more seriously because the computer graded it right away and then recorded the score. Also, teachers benefited from this technological advance because they did not have to grade and record the students' homework assignments. Based on these results, the authors felt that it would be cost-effective for school districts to purchase and create web-based homework (Mendicino, Razzaq, & Heffernan, 2009).

Most students have taken traditional paper and pencil assessments throughout their high school careers. Bottage, Rueda, Kwon, Grant, and LaRoque (2009) compared the performance of students who were given the same assessment, where one was given on a computer and the other was presented in the paper and pencil format. Despite past research, these authors found no differences in the total test score. Therefore, taking an assessment through a computer program does not give students an advantage. While computer-based assessments show no advantage for the students, they are cost and time effective for teachers. According to various research, what seems to be most beneficial for student achievement, motivation, and retention is instruction and homework via the computer software, games, and wed-based instruction.

Motivation

"Research on achievement motivation provides considerable evidence of classroom practices that nurture positive motivation" (Stipek, Salmon, Givvin, Kazemi, Saxe, & MacGyvers, 1998 pg. 465). This study assessed the associations between mathematics learning, student motivation, and teaching practices and the impact on achievement motivation (Stipek, Salmon, Givvin, Kazemi, & MacGyvers, 1998). There were many different finding presented in this study. The authors stated that there are documented motivational benefits of enjoyment in engaging mathematics. When a student is feeling enjoyment in mathematics class, they are more likely to keep working on a challenging task, work through problem-solving activities, be creative in class, and be cognitively flexible (Stipek, Salmon, Givvin, Kazemi, & MacGyvers, 1998). The study found that teachers who did not emphasize performance, but rather emphasized effort, learning, and understanding had students who scored higher on positive emotions and enjoyment in mathematics class (Stipek, Salmon, Givvin, Kazemi, & MacGyvers, 1998). Likewise, students who have their papers returned with feedback are associated with positive experiences in mathematics class (Stipek, Salmon, Givvin, Kazemi, & MacGyvers, 1998).

Another recent motivational study research the correlation between a mathematics classroom community of inquiry and teachers perceptions of student motivation (Gross, 2004). Gross (2004) wanted to find out what specific actions a teacher might take to create and inquiry-learning culture in a secondary math classroom. The author compiled the data from two consecutive years and regrouped her results into five statements that appeared to reflect what teachers' attitudes and expectations are about learning and teaching in a mathematics room.

First, when students work together, mathematical thinking can be tested if the students are at the same ability level. Second, if a teacher used scaffolding, mathematical thinking can develop through the process of inquiry. Third, when students learn how to self-reflect and self-monitor their math work, the process of mathematical inquiry can be accomplished. Fourth, when teachers use mathematical language formally and informally, students adopt the conventions of mathematical communication. Fifth, when learning a new mathematical concept, the teacher must withhold judgment in order to invite students to comment, participate, provide ownership, have whole class discussions, and offer justifications.

Beal, Qu, and Lee (2008) investigated the relationship of students' mathematics motivation and achievement while using geometry instructional software. Students completed a survey about their own personal mathematical motivation. In this study, motivation was defined by math self-concept beliefs and beliefs that math is important to learn (Beal, Qu, & Lee, 2008). The results showed that mathematically unmotivated students were more likely to guess incorrectly when using geometry instructional software. Students who felt highly motivated in mathematics class used appropriate help-seeking approaches when they used the geometry instructional software, therefore they scored significantly better than students who did not feel motivated in mathematics class. When students were playing against a computer video game, they wanted to out-smart the computer, therefore teachers encouraged this idea because it appeared to be a motivational factor (Houssart, & Sams, 1998).

A recent study investigated the relationship between students' attitudes toward mathematics (ATM) and achievement in mathematics (AIM). My research questions are related to students' attitudes toward mathematics class, therefore I found this article interesting. The research questions are (Ma, Z., & Kishor, N. 1997):

1. What is the magnitude of the general relationship between ATM and AIM, using the common metric r (correlation coefficient)?
2. Is this relationship consistent across gender, grade, ethnicity, sample selection, sample size, and the time period covered by this review?
3. How is this relationship affected by interaction effects among gender, grade, and ethnicity?
4. What is the magnitude of the causal relationship between ATM and AIM?

This research article states that most research done on this topic is qualitative. This research article is quantitative because it is done by 'Meta-Analysis.' This article states "Meta-Analysis has been identified as an effective way to apply quantitative methods to combining evidence from different studies" (Ma, Z., & Kishor, N. 1997).

This research article goes into detail about the population. This research looked at 113 primary studies and 82,941 students. Also, the article states the independent and dependent variables, effect size, statistical rational, and data analysis.

The overall effect of the relationship between ATM and AIM was found to be significant, positive and reliable, but not strong. The effect of gender on the relationship between ATM and AIM was found not to have a significant effect. When the study was done with the genders separated there was a slight significance. The effect of grade level on the relationship between ATM and AIM was found to be stronger in junior and high school versus elementary school level. The effect of ethnicity on the relationship between ATM and AIM was very interesting. Asian and African American students showed evidence that positive ATM is strongly correlated with high AIM. White students showed no statistically significant relationships between ATM and AIM. When all the different ethnic groups were placed together there was a weaker statistically relationship (the same idea happen with gender). The effect on sample selection on the relationship between ATM and AIM was only significant when there was a random sample. The effect on sample size on the relationship between ATM and AIM was very weak when there was less than 300 participants. The effect of the date of publication on the relationship between ATM and AIM was different for different time periods. Before the year 1975 there was no significant relationship found. I believe there probably was but there was not enough research conducted. The strongest relationship was found between the years 1976-80. The relationship was not as strong from that year on but remained constant.

I am very surprised by results from this research. Before I read this article I thought there would have been a strong relationship between ATM and AIM. This research article made me think deeper about each one of my students. I have one student who has told me numerous times that she wants to be a math teacher and loves math. This student is a very low achiever in math. I have another student who does not like math but is one of my top achievers in my Geometry Regents Honors class. These two examples are aligned with what I discovered from reading and studying this particular research article. While some students in these studies had positive or negative attitudes about technology, computer games, or mathematics class, students who have positive or negative attitudes toward mathematics do not have a significant relationship with their achievement in mathematics (Ma, & Kishor, 1997).

Chapter 3: Methodology

Participants

This study looked at two Geometry Regents classes. There were eight students from each class involved with this study, but each class has ten students enrolled. The students in these classes have a wide range of abilities and grade level. All of these students have passed the state's minimum requirement exam, which is Integrated Algebra Regents. These students are seeking their second, third, or fourth math credit for high school. There was no classified special education students enrolled in either of these classes. These students go to a small urban high school in the city of Rochester, New York. These two classes meet 364 minutes a week, where computer labs are always available.

Geometry Regents is typically a one year Regents course for 10^{th} graders. These students are in grades 10, 11, and 12 and are completing the course in one school year. Most students at this high school take Geometry Regents in two years. These participants scored well in Integrated Algebra Regents, therefore got placed in the one year Geometry Regents course. The researcher taught all sections of Geometry Regents and Essentials of Geometry (the two-year Geometry course) for the 2010-2011 school year. The researcher has taught Geometry Regents for the past three school years.

This study was approved by the building principal several months before it started. A few units before the circles and transformation unit began the researcher handed out parental consent forms and student consent forms. When the forms were handed out to the class, the researcher explained the possible benefits and purpose of the study. The researcher emphasized to the participants that this study was not going to affect their grade in any way and that they could stop being involved at any time. In period 1 there were 6 girls and 2 boys participating and in period 5 there were 5 girls and 3 boys participating. After all consent forms were brought back the researcher explained more information about the study, thanked them for being involved, and asked if any of them had any questions or concerns.

Experimental Design

During this study, students learned and completed the circles and transformations units. Last school year the researcher's students were successful with the lesson plans, which were based upon the district provided guide that involved some interactive technology and many non-technological hands on activities. For the circle unit, period one learned the unit with the researcher's lesson plans from last school year and period five learned the circles unit with lesson plans that the researcher created this year based upon the research conducted. For the transformation unit period one learned this unit with lesson plans that the researcher created this school year based upon the research and period five learned from the lesson plans that the researcher made last school year.

Both sections were taught in the same classroom. The classroom is small compared to the other classrooms in this high school, but does have big windows. The classroom is shaped like a rectangle and the desks are arranged into a square-like horseshoe. In the middle of the horseshoe is a big table with 5 chairs around it, where students can sit and complete their work with the researcher. The SMART Board is the focal point for the room, and all of the desks are facing it. This SMART Board has a projector arm attached to it and runs through the researcher's desk top computer. The arm allows for more room in the classroom and for SMART Notebook lessons to run smoother. Also, this classroom has three large chalk boards.

The computer lab used in this study is adjacent to the researcher's classroom. The computer lab has all brand new computers. It is a big corner classroom, with large windows on two of the walls. It holds 25 desks in the middle, and a SMART Board. This SMART Board does not have projector arm and is not hooked up to a desk top computer, therefore you need to have a laptop and projector cart from the school's main office.

This entire study took six weeks to complete, ending May 2011. The circles unit was four weeks long and the transformations unit was two weeks long. The lesson plans that are included in the appendix are the enhanced technology lessons. The fifteen circles lesson plans are what period 5 completed. The ten transformation lesson plans are what period 1 completed. For the circles unit, every time period 5 went to the computer lab or when students taught the class at the SMART Board period 1 used the textbook, made posters, made flash cards, did number puzzles, or worked out of Barron's Geometry Regents Review Book. For the transformations unit, every time period 1 went to the computer lab or when students 'taught the class at the SMART Board' period 5 used the textbook, made posters, made flash cards, did number puzzles, or worked out of Barron's Geometry Regents Review Book. For the circles unit, period 5 often did assignments on regentsprep.org for homework, where period 1 had all of theirs on paper worksheets. For the transformation unit period 1 often did assignments on regentsprep.org for homework, where period 5 had all of theirs on paper worksheets. All classes played review Jeopardy as a class. For the circles unit period 5 came up (students were on a rotation) to the SMART Board and completed the warm-up, where in period 1 the researcher completed the warm-up. For the transformation unit, period 1 came up (students were on a rotation) to the SMART Board and completed the warm-up, where in period 5 the researcher completed the warm-up. All classes had the same short guided notes that contain definitions, pictures, and examples presented by the researcher at the SMART Board. Students would pick up these guided notes as they walk into the classroom. Please refer to Table 1 for further information and understanding.

Table 1: Lesson Plans by Class Period

Class Period/Unit	Circles	Transformations
1st Period	Traditional Lesson Plans	Enhanced Technology Lessons Plans
5th Period	Enhanced Technology Lessons Plans	Traditional Lesson Plans

Geometer's Sketchpad was installed on all computers in the computer lab next to the researcher's classroom. Period 1 and Period 5 had never been exposed to or utilized Geometer's Sketchpad, Studyjams.scholastic.com, and Geometrybits.com before this study. Period 1 and Period 5 have seen and used Regentsprep.org multiple times. Period 1 and 5 have never created anything in SMART Notebook before this study and have never presented anything using the SMART Board before this study. The researcher chose to have Geometer's Sketchpad the main piece of enhanced technology because the district already had bought a license for it and due to o the amount of positive research.

The data was collected quantitatively and qualitatively through a survey and unit exam. At the conclusion of the circles unit both class periods took the same unit exam. Two weeks later at the conclusion of the transformation unit both class periods took the same unit exam. After both units were completed, the students completed a survey on technology in the mathematics classroom. Unlike the unit exams, the survey was taken anonymously to encourage students to give honest feedback. The unit exam and the survey were written by the researchers.

Data Collected and Analysis

To answer the first research question, "Does the use of technology in a mathematics classroom result in better student performance?" the researcher compared the unit exams scores by computing the averages and the standard deviation. The researcher looked at the difference of the circles and transformations until exam to illustrate which class had better understanding.

To answer the second research question, "Do students feel more motivated to do better in mathematics class when technology is used in the classroom?" and the third research question, "Do students have positive attitudes and perceptions towards mathematics class when technology is used in the classroom?" a survey was administered to each student. The survey consisted of nine questions on a four point liker-type scale. The questions ranged from one 'Strongly Disagree,' two 'Disagree,' three 'Agree,' and four 'Strongly Agree.' This part of survey created quantitative data that was put into a chart and compared. The survey also had three general questions at the top:

1. Which class period are you in: 1st or 5th?
2. Which unit did you enjoy more: Circles or Transformations?
3. Which unit was there more technology used throughout the unit: Circles or Transformations?

The three general questions were also put into a chart and illustrated results. Both charts can be found in the appendix chapter.

Limitations

This study had some limitations that minimize its true effectiveness of generalizing if there is enhanced technology in the geometry classroom there will be better student performance, students will feel more motivated in the mathematics classroom, and students will have positive attitudes and perceptions towards mathematics class. This study was conducted over a short six week time frame and only compared two units. Typically Geometry Regents is taken by tenth graders in

New York and is their second math credit. The researcher's Geometry Regents class contains students from grades 10th through 12th who are obtaining their second through fourth math credit. Therefore some of the researcher's students have more mathematical background knowledge than your typical Geometry Regents Student.

The researcher has extremely small class sizes this school year, having only ten students enrolled in each class when this study started. Of these ten students in each class there was one 'no show' student (a student who has not been present all school year) and one student with very poor attendance, leaving only eight students in each class period to participate. With such small class sizes the teacher was able to work one-on-one with students very often. Therefore, other school may have bigger class sizes and less one-on-one time.

In the researcher's school, all regents' mathematics courses meet 364 minutes a week versus the non-regents classes who meet 260 minutes a week. In the researcher's building there are three other schools where the Geometry Regents classes only meet 210 minutes a week. Due to the extra time in the researchers Geometry Regents classes, she was able to spend quality time in the computer lab doing a variety of activities. Therefore, other schools may not have the time to complete as many technology-centered activities.

In regards to the units that were studied, the circles and the transformation units were covered over different time periods. The circles unit was 15 class periods long and the transformation unit was 10 class periods long. The researcher had to do these units because they were the only units left in the curriculum and based on the district pacing chart. In the future, a student could be done where the units are completed over the same amount of class periods.

The researcher works at a small high school, where all the students know each other. These students from period 1 and 5 communicate with each other in the hall, in other class periods, and at lunch. Also, it is important to know, the researcher taught both period 1 and period 5. In the future, a similar study could be conducted at a bigger high school and with more teachers involved.

Chapter 4: Results

This study investigated the relationship between the use of technology in the Geometry Regents classroom and student performance, motivation, positive attitudes, and perceptions towards mathematics class. There were two classes involved with this study, period 1 and period 5. The study had three research questions that resulted in quantitative and qualitative data. The two unit exams were used to measure the students' performance. The survey was used to examine student thoughts on motivation, attitudes, and perceptions toward the use of technology in the mathematics classroom

Student Performance: Period 1 versus Period 5
Circles Unit

All participants took the same unit exam for the circles unit. Period 5 was taught using the enhanced technology lesson plans and labs found in the appendix where period 1 did more traditional assignments throughout the unit. This unit lasted for fifteen class periods. The exam consisted of twenty multiple choice questions worth two points each, three parts II questions worth three points each, four part III questions worth four points each, and three part IV questions worth five points each. The exam is 100 points total. To examine student performance, the researcher looked at the unit exam scores from period 1 and period 5, and then compared class average against each other. This is illustrated in Table 2.

In both sections there are students from grades ten through twelve; therefore, there is a large variation mathematical ability and exposure. In each section, there are students who typically excel on unit exams and students who typically score poorly.

Due to this variation in ability, it lead to a wide range of test scores, which caused the standard deviation for the circles unit exam to be high. Having a high standard deviation can skew the results. This is illustrated in Table 3 and 4.

Table 2: Each Student's Circle's Unit Exam Score

Circle Unit Exam: Period 1	Circle Unit Exam: Period 5
72	48
58	85
95	59
77	98
75	72
66	63
46	78
69	83
Class Average: 69.75	Class Average: 73.25

Table 3: Standard Deviation for Circles Unit Exam: Period 1

Circles Unit Exam Results: Period 1
Total Numbers:8
Mean (Average):69.75
Standard deviation: 14.34025
Variance(Standard deviation):205.64286
Population Standard deviation:13.41408
Variance(Population Standard deviation):179.9375

Table 4: Standard Deviation for Circles Unit Exam: Period 5

Circles Unit Exam Results: Period 5
Total Numbers:8
Mean (Average):73.25
Standard deviation:16.10457
Variance(Standard deviation):259.35714
Population Standard deviation:15.06444
Variance(Population Standard deviation):226.9375

Table 5: Circles Unit Exam P-Value

Circles Unit Exam
P value and statistical significance:
The two-tailed P value equals 0.6976
By conventional criteria, this difference is considered to be not statistically significant.
Confidence interval:
The mean of Period 1 minus Period 5 equals -3.50
95% confidence interval of this difference: From -23.93 to 16.93
Intermediate values used in calculations:
t = 0.4050
df = 7
standard error of difference = 8.642

Table 6: Circles Unit Exam: Review of Data

Review of data: Circles Unit Exam		
Group	**Period 1**	**Period 5**
Mean	69.75	73.25
SD	14.34	16.10
SEM	5.07	5.69
N	8	8

Student Performance: Period 1 versus Period 5
Transformations Unit

All participants took the same unit exam for the transformation unit. Period 1 was taught using the enhanced technology lesson plans and labs found in the appendix where period 5 did more traditional assignments throughout the unit. This unit lasted for ten class periods. The exam consisted of twenty multiple choice questions worth two points each, three parts II questions worth three points each, four part III questions worth four points each, and three part IV questions worth five points each. The exam is 100 points total. To examine student performance, the researcher looked at the unit exam scores from period 1 and period 5, and then compared class average against each other. This is illustrated in Table 7.

The results from comparing the exam scores are very similar for both units. The standard deviations for the transformation unit are very high, therefore making it difficult to conduct more tests. This is illustrated in Table 8 and 9.

Table 7: Each Student's Transformation's Unit Exam Score

Transformation Unit Exam: Period 1	Transformation Unit Exam: Period 5
58	84
87	83
81	51
92	93
96	84
78	94
91	78
69	55
Class Average: 81.5	Class Average: 77.75

Table 8: Standard Deviation for Transformations Unit Exam: Period 1

Transformations Unit Exam Results: Period 1
Total Numbers: 8
Mean (Average):81.5
Standard deviation:12.8841
Variance(Standard deviation):166
Population Standard deviation:12.05197
Variance(Population Standard deviation):142.25

Table 9: Standard Deviation for Transformations Unit Exam: Period 5

Transformations Unit Exam Results: Period 5
Total Numbers: 8
Mean (Average): 77.75
Standard deviation: 16.19303
Variance(Standard deviation): 262.21429
Population Standard deviation: 15.14719
Variance(Population Standard deviation): 229.4375

Table 10: Transformations Unit Exam P-Value

Transformations Unit Exam
P value and statistical significance:
The two-tailed P value equals 0.5723
By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:
The mean of Period 1 minus Period 5 equals 3.75
95% confidence interval of this difference: From -11.22 to 18.72

Intermediate values used in calculations:
t = 0.5922
df = 7
standard error of difference = 6.332

Table 11: Transformations Unit Exam: Review of Data

Review of data: Transformations Unit Exam

Group	Period 1	Period 5
Mean	81.50	77.75
SD	12.88	16.19
SEM	4.56	5.73
N	8	8

From calculating two-tailed P values, illustrated in Tables 5 and 10 for both units there was no statistical significance found. This means enhancing technology in the classroom does not necessarily mean student performance will increase. When looking at Table 6, the review of data for the circles unit you can see that the mean of period 5 (who had the enhanced technology) was slightly higher than the mean of period 1. When looking at Table 11, the review of data for the transformations unit you can see that the mean of period 1 (who had the enhanced technology) was slightly higher than the mean of period 5.

Student Perceptions on Motivation and Positive Attitudes toward Mathematics Class.

To examine student perceptions on motivation and positive attitudes towards mathematics class, both sections completed a survey after the circles and transformations units were concluded. The survey had general questions about the use of technology, more specifically about the SMART Board and the computer lab. The survey consisted of nine questions on a four point likert-type scale. The questions ranged from one 'Strongly Disagree,' two 'Disagree,' three 'Agree,' and four 'Strongly Agree.' This part of the survey created quantitative data that was put into a chart and compared. The survey also had three general questions at the top, they were:

1. Which class period are you in: 1^{st} or 5^{th}?
2. Which unit did you enjoy more: Circles or Transformations?

3. Which unit was there more technology used throughout the unit: Circles or Transformations?

The three 'circle your choice' questions can be found on Table 12. The average responses of the nine likert-type questions from period 1 and 5 can be illustrated on Table 13. All twelve survey questions are analyzed below. Questions 1, 4-12 are analyzed by comparing period 1 against period 5, where questions 2 and 3 are analyzed by comparing the circle unit against the transformations unit. Survey questions 1 through 3 are analyzed by how many students chose each response, there were 16 students total. Survey questions 4-12 are analyzed by the class average, where 4 indicates strongly agree and 1 indicates strongly disagree.

1. *Which class period are you in:*
   Period 1: 8 Period 5: 8
   Both sections had 8 students participate in this study.

2. *Which unit did you enjoy more:*
   Circle Unit: 6 Transformations Unit: 10
   Some students said they felt that the circles unit was more difficult than the transformations, leading them to enjoy the transformation unit more. Despite having enhanced technology during the circles unit in period 5, three students said they enjoyed the transformations unit more. In period 1, where they had enhanced technology for the transformations unit all students except one said they enjoyed the transformation unit more.

3. *Which unit was there more technology used throughout the unit:*
   Circle Unit: 8 Transformations Unit: 8
   All students knew which unit their class got to have enhanced technology.

4. *I felt happy when I knew my class was going to the computer lab:*
   Period 1: 3.25 Period 5: 3.78
   Both sections had a very positive response to this question. When the classes did not go to the computer lab there would be 104 minutes in the same

classroom. Many students expressed that going to the computer lab made class time go by quickly.

5. *I felt happy when I went up to the SMART Board:*
   Period 1: 3.50 Period 5: 3.50
   Both sections felt the same about this statement. This positive response was reflected in the student's faces when they knew they were going to write on the SMART Board.

6. *I felt that I learned more when my class went to the computer lab during math lab time:*
   Period 1: 2.75 Period 5: 2.38
   This question had the most negative response. The researcher believes this occurred because the non-computer lab activities had more calculations, which may lead student to believe they were 'learning more' during those activities.

7. *I felt I learned more when I got to use the SMART Board myself:*
   Period 1: 3.50 Period 5: 2.75
   It is surprising to see that 5^{th} period's response is much more negative than 1^{st} period. From observations 5^{th} period seemed to enjoy using the SMART Board more than 1^{st} period. The 5^{th} period class acted like true teachers when they were at the board.

8. *I completed my entire class work assignment when my class was in the computer lab:*
   Period 1: 3.13 Period 5: 2.50
   This was a very surprising response to look at because 5^{th} period got more classwork in the computer lab complete.

9. *I read the explanations that the computer programs provided me and it allowed me to understand the material.*
   Period 1: 3.25 Period 5: 2.88
   Both classes did very well in the computer lab, these positive responses were expected.

10. *I believe the technology in this mathematics classroom resulted in my performance in mathematics to increase:*
    Period 1: 3.13 Period 5: 3.63
    The unit where each class had enhanced technology, the class average on the unit exam was slightly better than the other class. In terms of statistics, the difference was not considered to be statistically significant. It is interesting how positive their responses are, since they only did slightly better when technology was enhanced.

11. *I feel more motivated to do better in my mathematics class when technology is used in the classroom:*
    Period 1: 3.50 Period 5: 3.00
    It is clear that both classes feel more motivated to do better in mathematics class when technology is used, but the difference is still surprising.

12. *I have positive attitudes and perceptions towards mathematics class when technology is used in the classroom:*
    Period 1: 3.25 Period 5: 3.63
    Both classes responded very positively to this survey question. Both sections seemed to be very excited when technology was involved with the lesson plans.

Overall both sections felt positive about perceptions on motivation, attitudes toward mathematics, and performance in mathematics when technology is being used in the classroom. In general 1st period responded more positively than 5th period.

Table 12: Summary Data Report: Survey Questions 1-3

1. Which class period are you in:	1st: 8	5th: 8
2. Which unit did you enjoy more:	Circles: 6	Transformations: 10
3. Which unit was there more technology used throughout the unit:	Circles: 8	Transformations: 8

Table 13: Summary Data Report: Survey Questions 4-12

Question	Average: Period 1	Average: Period 5
4. I felt happy when I knew my class was going to the computer lab:	3.25	3.78
5.I felt happy when I went up to the SMART Board:	3.50	3.50
6. I felt that I learned more when my class went to the computer lab during math lab time:	2.75	2.38
7. I felt I learned more when I got to use the SMART Board myself	3.50	2.75
8. I completed my entire class work assignment when my class was in the computer lab:	3.13	2.50
9. I read the explanations that the computer programs provided me and it allowed me to understand the material.	3.25	2.88
10. I believe the technology in this mathematics classroom resulted in my performance in mathematics to increase:	3.13	2.63
11. I feel more motivated to do better in my mathematics class when technology is used in the classroom:	3.50	3
12. I have positive attitudes and perceptions towards mathematics class when technology is used in the classroom:	3.25	3.63

Chapter 5: Discussion

In this study, the relationships between enhanced technology in the Geometry Regents class room and student performance, motivation, positive attitudes, and perceptions towards mathematics class were examined. Over the course of six weeks, two units were taught to two different sections of Geometry Regents, period 1 and period 5. For the first unit, 'Circles,' period 5 was taught with enhanced technology lessons, where period 1 continued to learn in the same style they have been accustomed to all school year. For the second unit, 'Transformations,' period 1 was taught with enhanced technology lessons, where period 5 went back to leaning with the same style they had been accustomed to all school year.

After instruction of the circles unit concluded, a unit exam was given to assess student performance. Both classes were given the same unit exam. After instruction of the transformations unit concluded, a unit exam was given to assess student performance. Again, both classes were given the same unit exam. Although the difference in the unit exam score was not statistically significant, the classes where the enhanced technology was used the class averages were slightly higher.

After the instruction of both units was concluded students were given a survey about their perceptions on enhanced technology in the Geometry Regents class room and student performance, motivation, and positive attitudes towards mathematics class. Overall, it showed that students feel positive about enhanced technology in the Geometry Regents class room and student performance, motivation, and positive attitudes towards mathematics class. In general period 1 felt more positive than period

5, which was very surprising to the researcher. From observations, period 5 seemed to be having a more overall positive experience with the enhanced technology. The researcher found the most surprising results to be survey question ten (I believe the technology in this mathematics classroom resulted in my performance in mathematics to increase) where the students responded that they agreed, but their actual performance on the unit exam was not that much higher from the enhanced technology unit.

As the researcher, I have learned a tremendous amount of information from doing this study. Before this study I was scared and nervous to introduce Geometers Sketchpad (GSP) to a class and use it for an entire unit. I was nervous that the students would not be able to use the program and would get frustrated. The exact opposite happened, both classes caught on quickly and never got frustrated when using GSP. The students produced incredible things while they were using GSP, when they had freedom on what to make. Students were so excited about what they made. They would print an extra copy and take it home to show their family. Period 1 often had to share the computer lab, the other teacher in the lab was always amazed when the students were working in GSP. I was very impressed by both classes use of vocabulary while using GSP. See student work under the appendix. In the future, if time permits I will use GSP in the Geometry classroom. These two sections created excellent examples to show my future students.

Both classes have worked on Regentsprep.org all school year in the computer lab only. I was very nervous to have students work on Regentsprep.org for homework assignments because not all students have a computer with Internet at home. To my surprise most students did complete all Regentsprep.org homework assignments. Students reported that they used a computer in the library or at school if they did not have one at home. In the future, I would give students Internet homework assignments throughout the school year

Neither class had ever used studyjams.scholastic.com before; therefore it was their first time using it this school year for class work or homework assignments. The students truly enjoyed this website for several reasons. They liked how the site graded their quizzes and then allowed them to go back and fix their mistakes. The students felt that this site had less challenging geometry questions, which was nice for the end of a double period. The students enjoyed the wide range of review questions this site had to offer. I would use this site in the future for class work and homework assignments.

I have had students from period 1 and period 5 come up and use the SMART Board them selves this school year, but not as frequently as during their classes enhanced technology unit. I have had students use the SMART Board themselves in the past few years. I believe it takes a very mature and well behaved class to have this be successful and educational in a classroom. Period 1 and period 5 are both very mature and well behaved; therefore this went well having the students teach the class for certain math problems. Period 5 seemed to get into the idea of 'You are the Teacher,' where the students teach and I sit and watch. Period 5 would even say things like, "Now students…," which was very enjoyable to watch.

Playing Jeopardy as a class through the SMART Board is something that both sections have done many times this school year. Period 1 and 5 have played Jeopardy at the end of every unit this school year; therefore both classes played Jeopardy for the circles and transformations units. Based on observations, period 1 enjoys playing Jeopardy more. Students in period 1 are never absent if they know when we are going to play, say 'YES' when they walk in the classroom and realize we are playing, and always have their partners picked out before class time or very quickly. There are always different winners in period 1 versus period 5 where the same two students almost always win. I would highly recommend playing Jeopardy as a technology review game, which is an easy way to incorporate technology into the math classroom. I have never seen a class not enjoy playing Jeopardy through the SMART Board.

My results are aligned with the current research about technology in the mathematics classroom. Past studies have shown some students had positive or negative attitudes about technology, computer games, or mathematics class, students who have positive or negative attitudes toward mathematics do not have a significant relationship with their achievement in mathematics (Ma, & Kishor, 1997). I would have liked there to have been a significant relationship between technology and their mathematical performance (achievement).

There needs to be more research done on SMART Boards and other SMART Technologies products. There is a lack of good journals and resources on SMART Technologies various software programs. The lack of information, research, and articles is surprising since the SMART technologies are widely used in classrooms all around the world. I believe motivation and attitudes are an important part of achievement in mathematics although research does not support it. For the surveys, I believe using the SMART Board to run other mathematical software such as GSP and educational websites made my students have more positive attitudes toward mathematics and be more motivated to do mathematics. Although my results did not show a significant improvement in achievement, I believe there still are many educational benefits for students and teachers when a SMART Board is being used in the classroom. Based on the student surveys, I am happy that they reported an overall positive relationship between SMART Boards, attitudes of mathematics, and motivation in mathematics. I was extremely pleased with how all students were engaged during this study, making it a great experience.

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Appendix
Circles Lesson Plans: Period 5

Lesson Plan: Circles Day 1

Subject: Mathematics-Geometry Regents

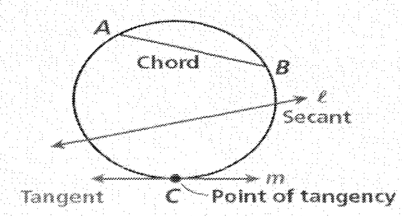
NYS Performance Indicators: G.G.50 and G.G.48

Essential Question: Can you understand and identify all of the lines and segments that intersect a circle?

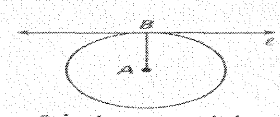
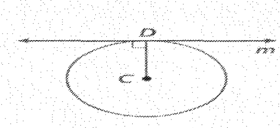
Mini Lesson: Vocabulary of Circles
- Identify tangents, secants, and chords.
- Use properties of tangents to solve problems.

Main Ideas:

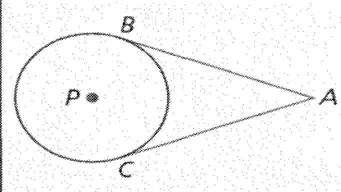
Lines and Segments That Intersect Circles

TERM	DIAGRAM
A **chord** is a segment whose endpoints lie on a circle.	
A **secant** is a line that intersects a circle at two points.	
A **tangent** is a line in the same plane as a circle that intersects it at exactly one point.	
The point where the tangent and a circle intersect is called the **point of tangency**.	

Theorems

	THEOREM	HYPOTHESIS	CONCLUSION
11-1-1	If a line is tangent to a circle, then it is perpendicular to the radius drawn to the point of tangency. (line tangent to ⊙ → line ⊥ to radius)	 ℓ is tangent to ⊙A	$\ell \perp \overline{AB}$
11-1-2	If a line is perpendicular to a radius of a circle at a point on the circle, then the line is tangent to the circle. (line ⊥ to radius → line tangent to ⊙)	 m is ⊥ to $\overline{CD}$ at D	m is tangent to ⊙C.

Theorem 11-1-3

THEOREM	HYPOTHESIS	CONCLUSION
If two segments are tangent to a circle from the same external point, then the segments are congruent. (2 segs. tangent to ⊙ from same ext. pt. → segs. ≅)	 $\overline{AB}$ and $\overline{AC}$ are tangent to ⊙*P*.	$\overline{AB} \cong \overline{AC}$

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples.
3. The class will go to the computer lab for their first GSP computer lab. See GSP-Circles 1.

Closure:

1. Students will complete a three question Ticket-Out the Door

Homework:

1. Students will go on RegentsPrep.org and complete problems.

Lesson Plan: Circles Day 2

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

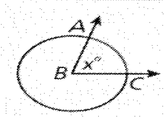
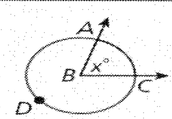
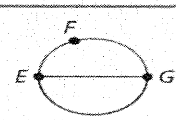
Essential Question: Can you identify and calculate arcs and central angles in circle problems?

Mini Lesson: Arcs and Angles inside circles

- Minor Arc
- Major Arc
- Semicircle
- Arc Addition Postulate
- Central Angles

Main Ideas:

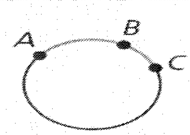
Arcs and Their Measure

ARC	MEASURE	DIAGRAM
A **minor arc** is an arc whose points are on or in the interior of a central angle.	The measure of a minor arc is equal to the measure of its central angle. $m\widehat{AC} = m\angle ABC = x°$	
A **major arc** is an arc whose points are on or in the exterior of a central angle.	The measure of a major arc is equal to 360° minus the measure of its central angle. $m\widehat{ADC} = 360° - m\angle ABC = 360° - x°$	
If the endpoints of an arc lie on a diameter, the arc is a **semicircle**.	The measure of a semicircle is equal to 180°. $m\widehat{EFG} = 180°$	

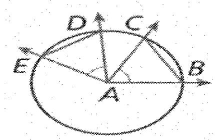
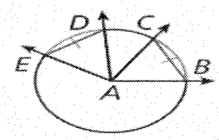
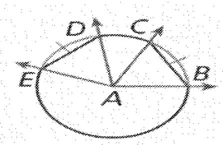
Postulate 11-2-1 **Arc Addition Postulate**

The measure of an arc formed by two adjacent arcs is the sum of the measures of the two arcs.

$$m\widehat{ABC} = m\widehat{AB} + m\widehat{BC}$$



Theorem 11-2-2

THEOREM	HYPOTHESIS	CONCLUSION
In a circle or congruent circles:		
(1) Congruent central angles have congruent chords.	 $\angle EAD \cong \angle BAC$	$\overline{DE} \cong \overline{BC}$
(2) Congruent chords have congruent arcs.	 $\overline{ED} \cong \overline{BC}$	$\overset{\frown}{DE} \cong \overset{\frown}{BC}$
(3) Congruent arcs have congruent central angles.	 $\overset{\frown}{ED} \cong \overset{\frown}{BC}$	$\angle DAE \cong \angle BAC$

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples.
3. Each student will complete three problems (all students have different problems). I will check the work of all students, then each student will teach the rest of them class about their math problems on the Smart Board.

Closure:

1. Students will complete a three question Ticket-Out the Door.

Homework:

1. Students will go on RegentsPrep.org and complete problems.

Lesson Plan: Circles Day 3

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

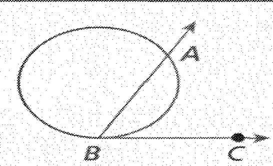
Essential Question: Do you know when to do the '½', '+', and '-' formula in circle problems?

Mini Lesson: Formulas in Circle Problems

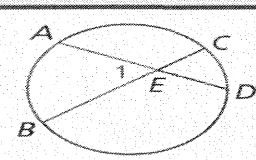
- ½ formula (when the angle is touching the outside of the circle!)
- + formula (when there is an X in the circle)
- - formula (when the angle is outside the circle)

Main Ideas:

Theorem 11-5-1

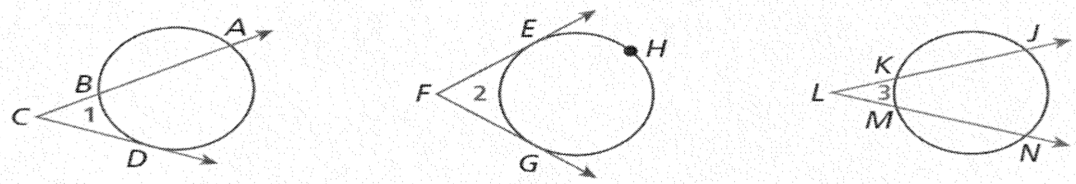
THEOREM	HYPOTHESIS	CONCLUSION
If a tangent and a secant (or chord) intersect on a circle at the point of tangency, then the measure of the angle formed is half the measure of its intercepted arc.	 Tangent $\overrightarrow{BC}$ and secant $\overrightarrow{BA}$ intersect at *B*.	$m\angle ABC = \frac{1}{2}m\widehat{AB}$

Theorem 11-5-2

THEOREM	HYPOTHESIS	CONCLUSION
If two secants or chords intersect in the interior of a circle, then the measure of each angle formed is half the sum of the measures of its intercepted arcs.	 Chords $\overline{AD}$ and $\overline{BC}$ intersect at *E*.	$m\angle 1 = \frac{1}{2}(m\widehat{AB} + m\widehat{CD})$

Theorem 11-5-3

If a tangent and a secant, two tangents, or two secants intersect in the exterior of a circle, then the measure of the angle formed is half the difference of the measures of its intercepted arcs.



$m\angle 1 = \frac{1}{2}(m\widehat{AD} - m\widehat{BD})$ $m\angle 2 = \frac{1}{2}(m\widehat{EHG} - m\widehat{EG})$ $m\angle 3 = \frac{1}{2}(m\widehat{JN} - m\widehat{KM})$

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples.
3. Students will go to the computer lab where GSP is installed on all of the computers and complete a lab assignment. See GSP Circles-2.

Closure:

1. Students will complete a three question Ticket-Out the Door.

Homework:

1. Students will go on RegentsPrep.org and complete problems.

Lesson Plan: Circles Day 4

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

Essential Question: Can you do a circle proof and solve circle problems with multiple rules in one picture?

Mini Lesson: Circle Proof

- Proofs
- Using all circle formulas in one circle problem.

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples.
3. Students will go to the computer lab where GSP is installed on all of the computers and complete a lab assignment. See GSP Circles-3.

Closure:

1. There are many important topics in the circle unit. Students have a small quiz tomorrow. The class is going to make a 'circle quilt.' Every few days we will add 'patches' to the quilt. Today, students are going to make their first patch. Students can pick any problem/topic from the last 4 days of learning.

Homework:

1. Students will go on RegentsPrep.org and complete one problem for homework. Numerical Practice with BIG Circles Problem 1
2. Students will do a traditional study guide review sheet.

Lesson Plan: Circles Day 5

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

Essential Question: Can you complete all of the problems we have learned the last 4 days?

Mini Lesson: Circles

- Review of Lesson plans 1-4

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains how to make a SMART Notebook lesson.
3. Students will go to the computer lab where SMART Notebook is installed on all computers. Students will create a SMART Note Book Presentation about everything they have learned the last 4 classes.

Closure:

1. Students will have about 5 minutes to show the class what they have made to help them study! Students will print a copy of their work, then I will copy it and give it to their classmates!

Homework:

1. No HW on Friday's if you completed (Monday-Thursday's HW)
2. Complete Monday-Thursdays HW if you have not done so!

Lesson Plan: Circles Day 6

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

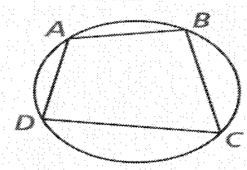
Essential Question: Can you complete mathematical problems where a quadrilateral is inscribed a circle?

Mini Lesson: Quadrilateral inscribed in a Circle

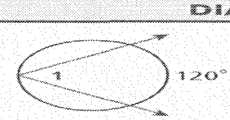
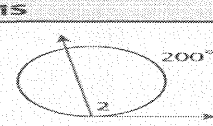
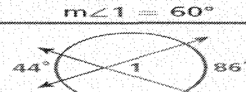
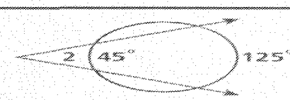
- Review of Lesson plans 1-4, everything mixed up.

Main Idea:

Theorem 11-4-4

THEOREM	HYPOTHESIS	CONCLUSION
If a quadrilateral is inscribed in a circle, then its opposite angles are supplementary.	 $ABCD$ is inscribed in $\odot E$.	$\angle A$ and $\angle C$ are supplementary. $\angle B$ and $\angle D$ are supplementary.

Angle Relationships in Circles

VERTEX OF THE ANGLE	MEASURE OF ANGLE	DIAGRAMS	
On a circle	Half the measure of its intercepted arc	 $m\angle 1 = 60°$	 $m\angle 2 = 100°$
Inside a circle	Half the sum of the measures of its intercepted arcs		$m\angle 1 = \frac{1}{2}(44° + 86°) = 65°$
Outside a circle	Half the difference of the measures of its intercepted arcs	 $m\angle 1 = \frac{1}{2}(202° - 78°) = 62°$	 $m\angle 2 = \frac{1}{2}(125° - 45°) = 40°$

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples.

3. I will pass out a class work activity. There are 10 problems on this paper. There are 10 students in the class. Each student will complete one problem. Each student will show all of their work to me.

Closure:
1. Each student will show/teach the class about their circle problem. All students will complete the 10 problems and hand in this paper.

Homework:
1.Part 1: Go to-
http://studyjams.scholastic.com/studyjams/jams/math/geometry/congruent-figures.htm
Press: Test Yourself!

Part 2: Go to:-
http://studyjams.scholastic.com/studyjams/jams/math/geometry/similar-figures.htm
Press: Test Yourself!

Lesson Plan: Circles Day 7

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

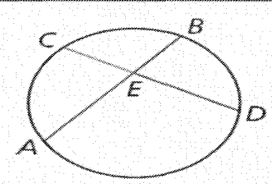
Essential Question: Can you identify and solve product theorems that involve circles?

Mini Lesson: Cords, Secants, and Tangents in Circles

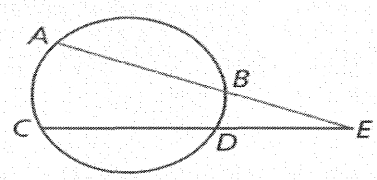
- Chord-Chord Product Theorem
- Secant-Secant Product Theorem
- Secant-Tangent Product Theorem

Main Idea:

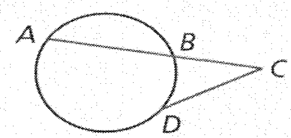
Theorem 11-6-1 Chord-Chord Product Theorem

THEOREM	HYPOTHESIS	CONCLUSION
If two chords intersect in the interior of a circle, then the products of the lengths of the segments of the chords are equal.	 Chords $\overline{AB}$ and $\overline{CD}$ intersect at E.	$AE \cdot EB = CE \cdot ED$

Theorem 11-6-2 Secant-Secant Product Theorem

THEOREM	HYPOTHESIS	CONCLUSION
If two secants intersect in the exterior of a circle, then the product of the lengths of one secant segment and its external segment equals the product of the lengths of the other secant segment and its external segment. (whole • outside = whole • outside)	 Secants $\overline{AE}$ and $\overline{CE}$ intersect at E.	$AE \cdot BE = CE \cdot DE$

Theorem 11-6-3 Secant-Tangent Product Theorem

THEOREM	HYPOTHESIS	CONCLUSION
If a secant and a tangent intersect in the exterior of a circle, then the product of the lengths of the secant segment and its external segment equals the length of the tangent segment squared. (whole • outside = tangent^2)	 Secant $\overline{AC}$ and tangent $\overline{DC}$ intersect at C.	$AC \cdot BC = DC^2$

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples.
3. Students will complete a two sided worksheet where they have to identify which theorem to use then solve each problem.
4. Students will go to the computer lab where GSP is installed on all of the computers and complete a lab assignment. See GSP Circles-4.

Closure:

1. There are many important topics in the circle unit. Students have a small quiz tomorrow. The class is going to make a 'circle quilt.' Every few days we will add 'patches' to the quilt. Today, students are going to make their second patch. Students can pick any problem/topic from today's notes or class work activities.

Homework:

1. Students will go on RegentsPrep.org and complete specific problems.

Lesson Plan: Circles Day 8

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

Essential Question: Can you complete all three kinds of the problems from last class?

Mini Lesson: Review Lesson Plan 7

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. Students know how to make SMART Notebook Presentations (learned in lesson plan 5).
3. Students will go to the computer lab where SMART Notebook is installed on all computers. Students will create a SMART Notebook Presentation about lesson plan 4. Students must include two examples of each kind of problem. Student can get these mathematical problems from their textbook.

Closure:

1. Students will have about 5 minutes to show the class what they have made to help them study! Students will print a copy of their work, then I will copy it and give it to their classmates!

Homework:

1. RegentsPrep.org assignment. On this assignment sheet there is also a textbook assignment.

Lesson Plan: Circles Day 9

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

Essential Question: Can you complete all kinds of circle problems from the last 8 days of the circle unit?

Mini Lesson: Review Lesson Plans 1-8

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. Today we are playing review Jeopardy on the SMART Board. Students will form groups of three or four. Every student will play. Each team is working against each other. The teams rotate picking questions, but every team completes each problem. I walk around and award points after every round. Each team will hand in one score sheet. The team with the most points receives bonus points on their test tomorrow. This game is very familiar to the students. They know the rules and how we play. Every student participating receives full class work points for the day

Closure:

1. Final Jeopardy- Today is a review day, therefore final Jeopardy serves as their TOTD. Each group will be handed the final Jeopardy. The group will decide before they see the question how many points they are going to risk. This final Jeopardy question is going to be very similar to the hardest question on the test tomorrow.

Homework:

1. RegentsPrep.org assignment. On this assignment sheet there is also a textbook assignment. This is Review for their quiz tomorrow.

Lesson Plan: Circles Day 10

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

Class Work: QUIZ

Lesson Plan: Circles Day 11

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

Essential Question: Can you write an equation of a circle and graph a circle?

Mini Lesson: Equation of a circle
- Graphing
- Equations.

Main Idea:

Theorem 11-7-1 **Equation of a Circle**

The equation of a circle with center (h, k) and radius r is $(x - h)^2 + (y - k)^2 = r^2$.

Class Work:
1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples.
3. Students will go to the computer lab where GSP is installed on all of the computers and complete a lab assignment. See GSP Circles-5. Students will use the Graph paper in GSP.

Closure:
1. There are many important topics in the circle unit. Students have a small quiz tomorrow. The class is going to make a 'circle quilt.' Every few days we will add 'patches' to the quilt. Today, students are going to make their third patch. Students can pick any problem from today's notes, class work, or section in the textbook.

Homework:
1. Students will go on RegentsPrep.org and complete certain problems.

Lesson Plan: Circles Day 12

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

Essential Question: Can you write an equation of a circle and graph a circle?

Mini Lesson: Equation of a circle
- Graphing
- Equations.

Main Idea:

Theorem 11-7-1 Equation of a Circle

The equation of a circle with center (h, k) and radius r is $(x - h)^2 + (y - k)^2 = r^2$.

Class Work:
1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples. There is some mixed review in this from the last 11 classes.
3. I will pass out a class work activity. There are 10 problems on this paper. There are 10 students in the class. Each student will complete one problem. Each student will show all of their work to me.

Closure:
1. Each student will show/teach the class about their circle problem. All students will complete the 10 problems and hand in this paper.

Homework:
1. Students will do a traditional study guide review sheet.

Lesson Plan: Circles Day 13

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

Essential Question: Can you graph circles and write the equation of a circle from looking at its graph?

Mini Lesson: Circle Graph and Equations

- Mixed Review from Circle Exam

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains mixed review for Unit exam
3. Students will go to the computer lab where GSP is installed on all of the computers and complete a lab assignment. See GSP Circles 6. This lab is a combination of GSP and MathBits.com!

Closure:

1. There are many important topics in the circle unit. Students have a small quiz tomorrow. The class is going to make a 'circle quilt.' Every few days we will add 'patches' to the quilt. Today, students are going to make their fourth patch. Students can pick any problem/topic from this entire unit.

Homework:

1. Students will go on RegentsPrep.org and complete the circles practice exam

Lesson Plan: Circles Day 14

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.49, G.G.50, G.G.51, G.G.52, and G.G.53

Essential Question: Can you complete all kinds of circle problems from this entire unit

Mini Lesson: Review Lesson Plans 1-14

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will put Regentsprep.org's circles unit exam up on the SMART Board and allow students to ask questions from their Homework.
3. Today we are playing review for Unit Exam Jeopardy on the SMART Board. Students will form groups of three or four. Every student will play. Each team is working against each other. The teams rotate picking questions, but every team completes each problem. I walk around and award points after every round. Each team will hand in one score sheet. The team with the most points receives bonus points on their test tomorrow. This game is very familiar to the students. They know the rules and how we play. Every student participating receives full class work points for the day

Closure:

1. Final Jeopardy- Today is a review day, therefore final Jeopardy serves as their TOTD. Each group will be handed the final Jeopardy. The group will decide before they see the question how many points they are going to risk. This final Jeopardy question is going to be very similar to the hardest question on the test tomorrow.

Homework:

1. Stay after school and ask questions from the Jeopardy game or about any question/misconception from the entire unit
2. Complete: Circles unit Exam Study Guide

Lesson Plan: Circles Day 15

UNIT EXAM

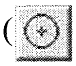
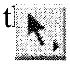
Circles: Examples of Technology Assignments

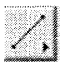
Name Date:
Mrs. Schroeder Geometry Regents

Geometers Sketchpad Computer Lab 1
Circles
Click: Start-Course software-Math- Geometers Sketchpad

Place a Check Mark in the boxes as you complete each step.

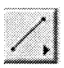
- *Answers the questions next to the bullets*

☐ 1. Open GSP, use the circle tool () to make a circle. Move the circle to where you want using t  tool.

☐ 2. Use the  tool to connect the center to the edge of the circle.

- What did you just create? ___________

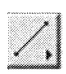
☐ 3. Click on your radius (make sure it is now pink) then select measure length.

☐ 4. Use the  tool to connect the center to the edge of the circle (select a different location)

- What did you just create? ___________

☐ 5. Click on your new radius (make sure it is now pink) then select measure length.

- What do you notice about the length of your two radiuses? ______________

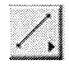
☐ 6. Create a diameter in your circle using the  tool.

☐ 7. Measure your diameter.

☐ 8. Select the endpoints of your diameter. They should be a pink/red color. Then select measure length.

- Compare the measure of the radius to the diameter. What do you notice?

____

9. Now we are going to make an angle. Click on the  tool. Touch the outside of the circle, then drag across the circle (click the mouse once) and then go back to the outside of the circle. You are making an inscribed angle.

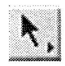
10. Right click on each point to give it a letter. Click 'label point'

- List 3 names for your angle (use words and symbols).

____

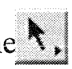
____

____

11. You are going to measure the angle. Use the  tool to select each point. You must select them in the proper order. Once the letters are pink/red select measure angle.

12. Click on the outside of the circle. Then select the 2 endpoints of your angle. Next, select Construct (on the top tool bar) and 'arc on circle.'

13. You arc should be pink/red (if not repeat step 12). Now select measure 'arc angle.'

14. Use the  to drag the angle measure and arc angle measure next to the angle and the arc.

- Compare the inscribed angle measure to the arc angle measure.

____

____

____

15. Measure an angle that is touching the center of the circle. Use the radius you created. Remember you must select the 3 points in the correct order. Once the measure appears drag it to the actual angle.

16. We want to find the measure of the arc that goes with the angle you measured in step 15. Select the entire circle (must be pink/red) then select the 2 endpoints of the arc. Then select Construct (on the top tool bar) and 'arc on circle.' (Just like you did in step 12)

☐ 17. Once the arc measure appears move it onto the arc.

- What do you notice about the measure of the angle that is touching the center of the circle and the arc measure?

____

____

____

☐ 18. Click File save. Save/Name you project something with your First and Last name in it. OR Print your Project!!!!

Name
Mrs. Schroeder

Date:
Geometry Regents

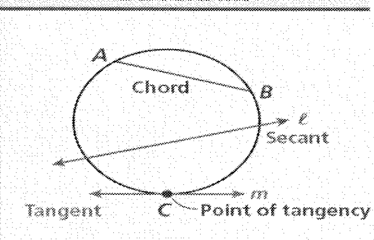
Geometers Sketchpad Computer Lab 2
Circles
Click: Start-Course software-Math- Geometers Sketchpad

1. Create a similar diagram in GSP, label all parts:

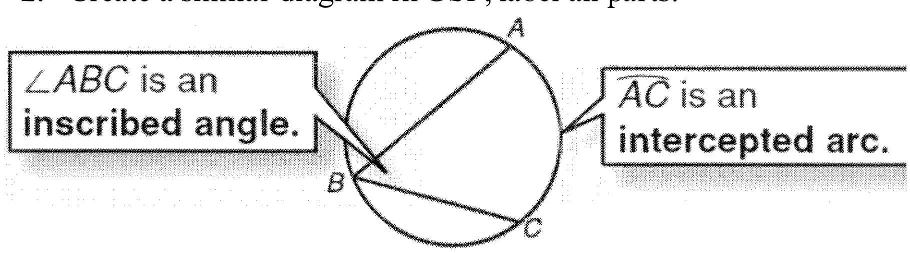
Lines and Segments That Intersect Circles

TERM
A **chord** is a segment whose endpoints lie on a circle.
A **secant** is a line that intersects a circle at two points.
A **tangent** is a line in the same plane as a circle that intersects it at exactly one point.
The point where the tangent and a circle intersect is called the **point of tangency**.

DIAGRAM



2. Create a similar diagram in GSP, label all parts:

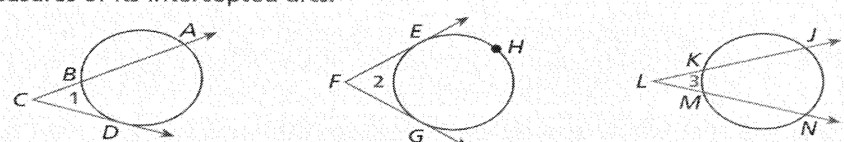


$$m\angle ABC = \frac{1}{2}m\overset{\frown}{AC}$$

3. Create a similar diagram in GSP, label all parts

Theorem 11-5-3

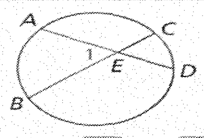
If a tangent and a secant, two tangents, or two secants intersect in the exterior of a circle, then the measure of the angle formed is half the difference of the measures of its intercepted arcs.



$m\angle 1 = \frac{1}{2}(m\overset{\frown}{AD} - m\overset{\frown}{BD})$ $m\angle 2 = \frac{1}{2}(m\overset{\frown}{EHG} - m\overset{\frown}{EG})$ $m\angle 3 = \frac{1}{2}(m\overset{\frown}{JN} - m\overset{\frown}{KM})$

4. Create a similar diagram in GSP, label all parts

Theorem 11-5-2

THEOREM	HYPOTHESIS	CONCLUSION
If two secants or chords intersect in the interior of a circle, then the measure of each angle formed is half the sum of the measures of its intercepted arcs.	 Chords $\overline{AD}$ and $\overline{BC}$ intersect at E.	$m\angle 1 = \frac{1}{2}(m\widehat{AB} + m\widehat{CD})$

5. Use you Holt Textbook (2008 version). Complete Problems 1-25 below. Then Pick 5 of them to re-create in GSP.

6. Click File save. Save/Name you project something with your First and Last name in it. OR Print your Project!!!!

Name
Mrs. Schroeder

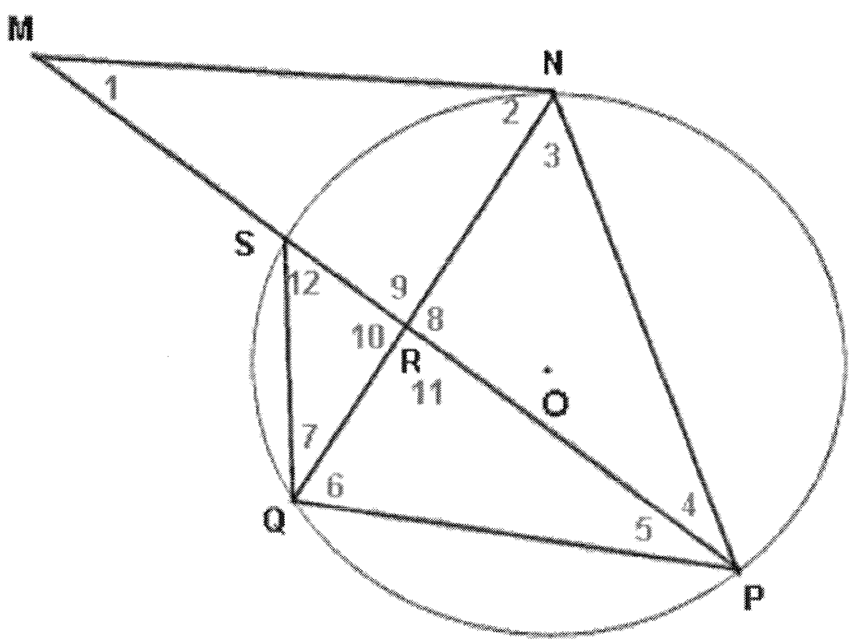
Date:
Geometry Regents

Geometers Sketchpad Computer Lab 3
Circles

Create your GSP pictures on one GSP page. Check all measurements. ***Print all Pictures!***

1. **Create your own complex circle problem. You must find at least 10 measurements. Any extra measurements will be extra credit! Everyone's picture will look <u>different! Be creative with what we have learned!</u>** ***Make sure your name is on the GSP picture!***

Example of a complex circle problem:

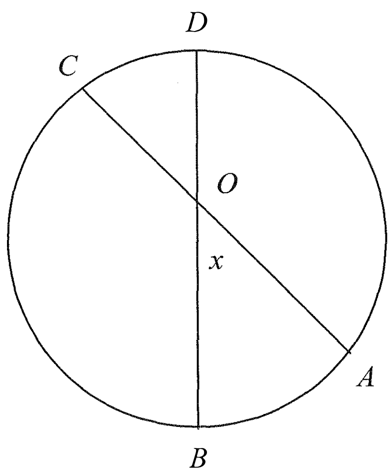


Name　　　　　　　　　　　　　　　　　　　　　　　　Date:
Mrs. Schroeder　　　　　　　　　　　　　　　　　　　Geometry Regents

Geometers Sketchpad Computer Lab 4
Circles

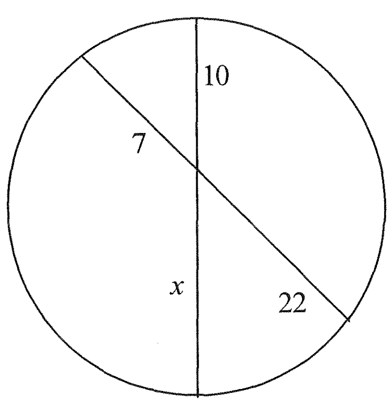
Create your GSP pictures on one GSP page. Check all measurements. ***Print all Pictures!***

1. Find the value of x for m(arc AB) = 46 and m(arc CD) = 21. (The figure is not drawn to scale.)



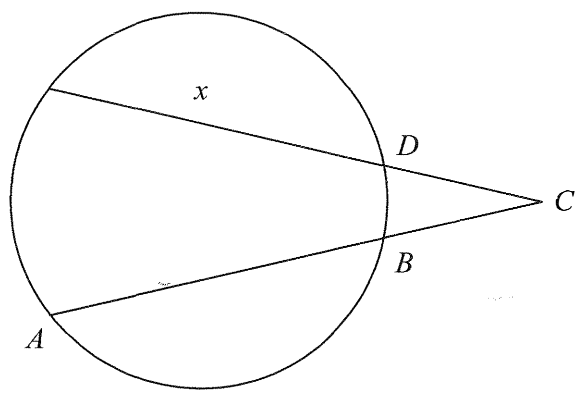
2. Create a similar problem (above) on GSP. Show all measurements. Save your work with your first and last name in the name. Check your calculations here:

3. Find x.



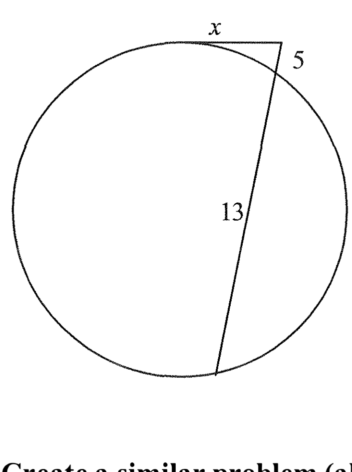
4. Create a similar problem (above) on GSP. Show all measurements. Save your work with your first and last name in the name. Check your calculations here:

5. $AB = 16$, $BC = 6$, and $CD = 8$



6. Create a similar problem (above) on GSP. Show all measurements. Save your work with your first and last name in the name. Check your calculations here:

7. Solve for x.



8. Create a similar problem (above) on GSP. Show all measurements. Save your work with your first and last name in the name. Check your calculations here:

Name
Mrs. Schroeder

Date:
Geometry Regents

Geometers Sketchpad Computer Lab 5
Circles

***Save all files with your first and last name! Print (if the printer is working!)**
*Click Graph, then Square Grid.

1. **Open your HOLT textbook to page 802. Complete question 1-4 below, then graph each in GSP. Put all 4 circles on 1 graph paper. Label each circle '1-4.'**

2. **Graph in GSP 5-8 and 14-17**

Name
Mrs. Schroeder

Date:
Geometry Regents

Geometers Sketchpad Computer Lab 6
Circles

1. Go to: http://mathbits.com/MathBits/GSP/GSP.htm
2. Click on:

Examining Angles in Circles	Geometry	Investigate central angles, inscribed angles, angles formed by a tangent and chord, angles formed by intersecting chords, angels formed by two secants, angles formed by a tangent and a secant, and angles formed by two tangents. Shows best on **1024 x 768** screen (or larger)

3. Complete assignment. Save/Print it.

4. Go to: http://mathbits.com/MathBits/GSP/GSP.htm
5. Click on:

Examining Segments in Circles	Geometry	Investigate the segment relationships in circles relating to chords, secants and tangents. Shows best on **1024 x 768** screen (or larger)

6. Complete assignment. Save/Print it.

Transformations Lesson Plans: Period 1

Lesson Plan: Transformations Day 1

Subject: Mathematics-Geometry Regents

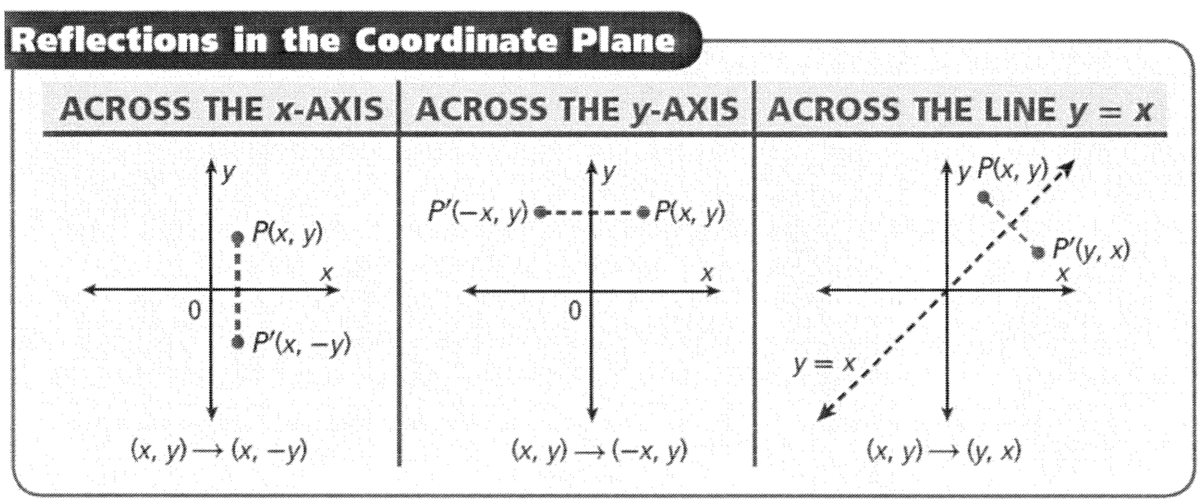
NYS Performance Indicators: G.G.54, G.G.55, G.G.56, G.G.57, G.G.58, and G.G.60

Essential Question: Can you identity a reflection, dilation, and transformation? Can you do problems that involve reflections in the coordinate plane?

Mini Lesson: Reflections

- x-axis
- y-axis
- the line y=x

Main Idea:



Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples. I will pass out a class work activity.
3. Students will go to the computer lab where GSP is installed on all of the computers and complete a lab assignment. See Transformation Lab 1.

Closure:

1. Students will print and share what they made in the computer lab.

Homework:

1. Students will go on RegentsPrep.org and complete certain problems about Reflections.

Lesson Plan: Transformations Day 2

Subject: Mathematics-Geometry Regents

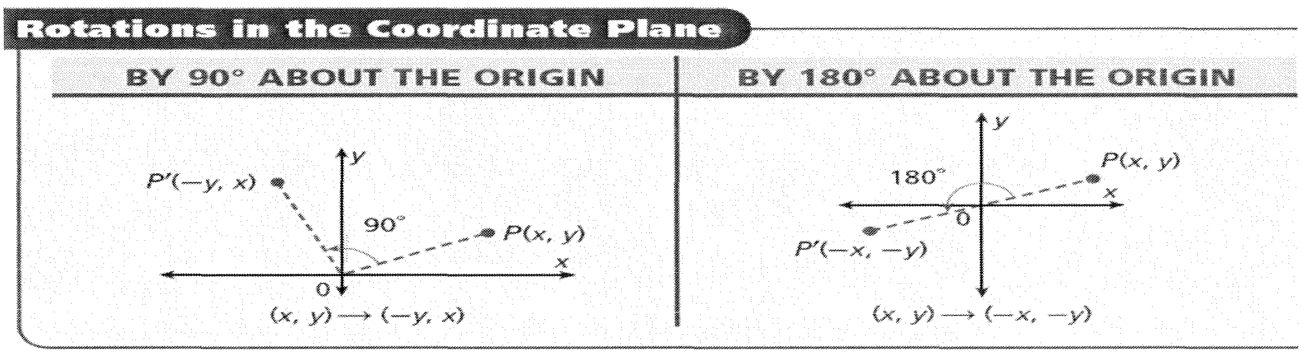
NYS Performance Indicators: G.G.54, G.G.55, G.G.56, G.G.57, G.G.58, and G.G.60

Essential Question: Can you identity a rotation? Can you do rotate a point, line, and triangle 90/180 degrees?

Mini Lesson: Rotations

- 90
- 180

Main Idea:



Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples. I will pass out a class work activity.
3. Students will go to the computer lab where GSP is installed on all of the computers and complete a lab assignment. See Transformation Lab 2.

Closure:

1. Students will complete a short TOTD on Regentsprep.org.

Homework:

1. Students will go on RegentsPrep.org and complete certain problems about Rotations.

Appendix

Lesson Plan: Transformations Day 3

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.54, G.G.55, G.G.56, G.G.57, G.G.58, and G.G.60

Essential Question: Can you identity if a figure has line symmetry

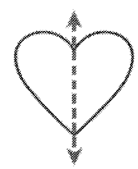
Mini Lesson: Line Symmetry

- Review of Rotations (90/180)

Main Idea:

Line Symmetry

A figure has **line symmetry** (or reflection symmetry) if it can be reflected across a line so that the image coincides with the preimage. The **line of symmetry** (also called the axis of symmetry) divides the figure into two congruent halves.



Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples. I will pass out a class work activity.
3. Students will go to the computer lab where GSP is installed on all of the computers and complete a lab assignment. See Transformation Lab 3.

Closure:

1. Students will complete a short TOTD on Regentsprep.org.

Homework:

1. Students will go on RegentsPrep.org and complete certain problems about line Symmetry.

Lesson Plan: Transformations Day 4

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.54, G.G.55, G.G.56, G.G.57, G.G.58, and G.G.60

Essential Question: Do you know everything about the last 3 days?

Mini Lesson: Review

- Review of Rotations (90/180)
- Reflections
- Line symmetry

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples. This is a mix of what we have done the last three days. I will pass out a class work activity.
3. I will pass out a class work activity. There are 10 problems on this paper. There are 10 students in the class. Each student will complete one problem. Each student will show all of their work to me.

Closure:

1. Each student will show/teach the class about their circle problem. All students will complete the 10 problems and hand in this paper.

Homework:

1. Students will do a traditional study guide review sheet.

Lesson Plan: Transformations Day 5
QUIZ

Lesson Plan: Transformations Day 6

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.54, G.G.55, G.G.56, G.G.57, G.G.58, and G.G.60

Essential Question: Do know how to complete a composition of transformation?

Mini Lesson: Dilations, Translations, and Compositions of Transformations

- Enlargement
- Reduction

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples. I will pass out a class work activity.
3. Students will go to the computer lab where GSP is installed on all of the computers and complete a lab assignment. See Transformation Lab 4.

Closure:

1. Students will complete a short TOTD on Regentsprep.org.

Homework:

1. Students will work on Regentsprep.org

Lesson Plan: Transformations Day 7

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.54, G.G.55, G.G.56, G.G.57, G.G.58, and G.G.60

Essential Question: Do know how to complete a composition of transformation?

Mini Lesson: Compositions of Transformations

- Mixed Review

Main Idea:

Transformation	Function Notation	Analytical Representation
Reflection across the x-axis	$r_{x\text{-axis}}$	$(x, y) \rightarrow (x, -y)$
Reflection across the y-axis	$r_{y\text{-axis}}$	$(x, y) \rightarrow (-x, y)$
Reflection across the line $y = x$	$r_{y=x}$	$(x, y) \rightarrow (y, x)$
Translation a units horizontally and b units vertically	$T_{a,b}$	$(x, y) \rightarrow (x + a, y + b)$
Rotation by 90° about the origin	$R_{O,90^\circ}$	$(x, y) \rightarrow (-y, x)$
Rotation by 180° about the origin	$R_{O,180^\circ}$	$(x, y) \rightarrow (-x, -y)$
Dilation centered at the origin with scale factor k	D_k	$(x, y) \rightarrow (kx, ky)$

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples. I will pass out a class work activity.
3. Students will go to the computer lab and work on Regentsprep.org. Students will do some mixed Regents review.

Closure:

1. Students will complete a traditional paper TOTD

Homework:

1. Students will work on Regentsprep.org

Lesson Plan: Transformations Day 8

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.54, G.G.55, G.G.56, G.G.57, G.G.58, and G.G.60

Essential Question: Do you know everything about this Transformation unit?

Mini Lesson: Unit review

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. I will go through a brief note packet that contains definitions, pictures, and examples. This is mixed review for unit exam I will pass out a class work activity.
3. Students will go to the computer lab and work on GeometryBits.com, these are GSP activities.
4. http://mathbits.com/MathBits/GSP/ScratchTransformations.htm
5. Students will complete Line Reflections, Point Reflections, and the Translation section.

Closure:

1. Students will present their final products from today's GSP activities.

Homework:

1. Students will work on Regentsprep.org

Lesson Plan: Transformations Day 9

Subject: Mathematics-Geometry Regents

NYS Performance Indicators: G.G.54, G.G.55, G.G.56, G.G.57, G.G.58, and G.G.60

Essential Question: Do you know everything about this Transformation unit?

Mini Lesson: Unit review

Class Work:

1. Students will come in and complete three warm-up questions. These questions are written in test format and are practice for their test tomorrow. Three different student will come up to the Smart Board and teach the class these three problems
2. Today we are playing review for Unit Exam Jeopardy on the SMART Board. Students will form groups of three or four. Every student will play. Each team is working against each other. The teams rotate picking questions, but every team completes each problem. I walk around and award points after every round. Each team will hand in one score sheet. The team with the most points receives bonus points on their test tomorrow. This game is very familiar to the students. They know the rules and how we play. Every student participating receives full class work points for the day
3. Lab Time (students have different lab times, so we cannot keep playing Jeopardy): Students will go to the computer lab and work on GeometryBits.com, these are GSP activities. Student can finish past GSP/Regentsprep.org assignments when finished with today's assignments since the unit is ending tomorrow.
4. http://mathbits.com/MathBits/GSP/ScratchTransformations.htm
5. Students will complete Dilation, Rotation, and the Glide Reflection section.

Closure:

1. Final Jeopardy- Today is a review day, therefore final Jeopardy serves as their TOTD. Each group will be handed the final Jeopardy. The group will decide before they see the question how many points they are going to risk. This final Jeopardy question is going to be very similar to the hardest question on the test tomorrow.

Homework:

1. Students will complete on Regentsprep.org the practice test to prepare them for tomorrows unit exam.

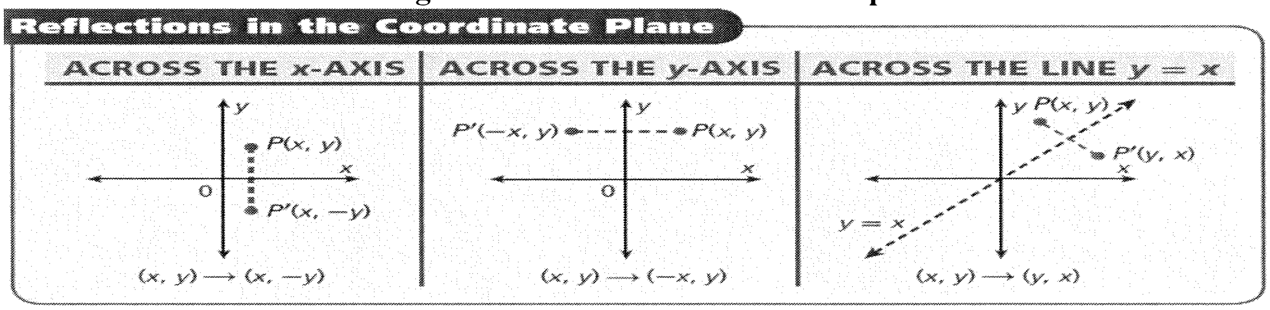
Lesson Plan: Transformations Day 10
UNIT EXAM

Transformations: Examples of Technology Assignments

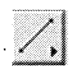
Name — Date:

Mrs. Schroeder — Geometry Regents

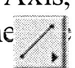
Geometers Sketchpad
Transformations Unit Lab 1: Reflections
Click: Start-Programs--CMST Geometers Sketchpad



1. Click Graph, then Square Grid.

2. Using the line tool () Make a Triangle. Any triangle you want! Write the points down.

A (____, ____) B (_____, ______) C (_____,_____)

3. Reflect your triangle across the x-Axis, y-Axis, and the line y=x. First write down your new points below. Then use the  tool ( ) make your new triangles Triangle.

Reflect across the x-Axis: D (____, ____) E (_____, ______) F (_____,_____)
Reflect across the y-Axis: G (____, ____) H (_____, ______) I (_____,_____)
Reflect across the line y=x J (____, ____) K (_____, ______)
L (_____,_____)

4. Look at your Triangle ABC. Click on line AB so that it is pink. Then click 'Measure' length. Then do the same for BC and CA.

5. Then click on all three of the lengths (they should be pink) and select 'Measure' calculate. A calculator should appear! Now one-by-one click: AB+BC+CA.

6. What did you just measure? ____________________.

7. Repeat Question 5 for Triangle DEF.

8. Do they have the same Perimeter? _________________.

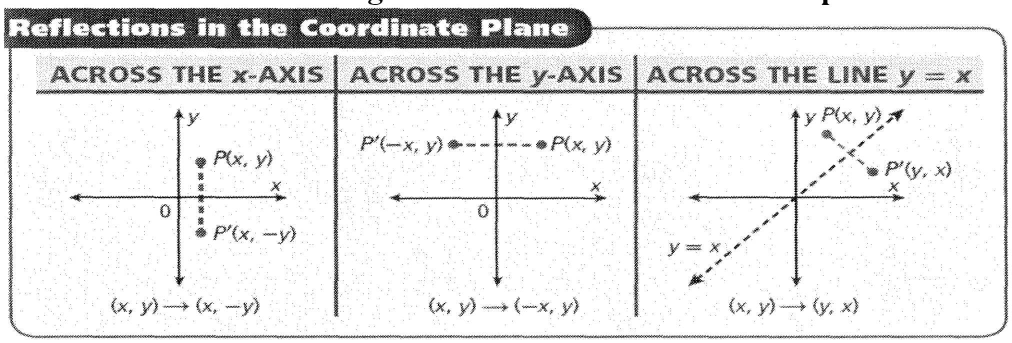
9. Put your name on this. Click the **A** on the left tool box column to do this!

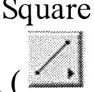
10. Click File save. Name you project something with your First and Last name in it. OR Print your Project!!!! Mrs. Schroeder will save this on her flash drive too!

Name
Mrs. Schroeder

Date:
Geometry Regents

Geometers Sketchpad
Transformations Unit Lab 2: Reflections
Click: Start-Programs--CMST Geometers Sketchpad



1. Click Graph, then Square Grid.
2. Using the line tool () Make something, anything you want (could be- your name, star, house, letters…)! Must have at least 10 points!
3. Write the points down.

4. Reflect your 'something' across the x-Axis, y-Axis, **OR** line y=x (pick one). First write down your new points below. Then use the  tool ( ) make your new 'something'.

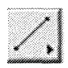
5. Put your name on this. Click the **A** on the left tool box column to do this!
6. Click File save. Name you project something with your First and Last name in it. OR Print your Project!!!! Mrs. Schroeder will save this on her flash drive too!

Name | Date:
Mrs. Schroeder | Geometry Regents

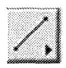
Geometers Sketchpad Computer Lab 3
Transformations
Click: Start-Programs--CMST Geometers Sketchpad

Rotation about Origin	**Rule**
90^{o}	(x, y) → (-y , x)
180^{o}	(x, y) → (-x, -y)
270^{o}	(x, y) → (y, -x)

1. Click Graph, then Square Grid.

2. Using the line tool () Make a Triangle. Any triangle you want! Write the points down.

A (____, ____) B (_____, _______) C (_____,_____)

3. Now Rotate your graph 90 and 180. First write down your new points below. Then use the line tool () make your new triangles Triangle.

Rotation 90: D (____, ____) E (_____, ______) F (_____,_____)
Rotation 180: G (____, ____) H (_____, ______) I (_____,_____)

4. Look at your Triangle ABC. Click on line AB so that it is pink. Then click ‘Measure’ length. Then do the same for BC and CA.

5. Then click on all three of the lengths (they should be pink) and select ‘Measure’ calculate. A calculator should appear! Now one-by-one click: AB+BC+CA.

6. What did you just measure? ____________________.

7. Repeat Question 5 for Triangle DEF.

8. Do they have the same Perimeter? _________________.

9. Put your name on this. Click the **A** on the left tool box column to do this!

10. Click File save. Name you project something with your First and Last name in it. OR Print your Project!!!! Mrs. Schroeder will save this on her flash drive too!

Name | Date:
Mrs. Schroeder | Geometry Regents

Geometers Sketchpad Computer Lab 4: Compositions
Transformations Unit
Click: Start-Programs--CMST Geometers Sketchpad

1. Make a picture of something (at least 15 points)
2. Write down the points:

3. Make up your own Composition

(Example: $R_{90^\circ} \circ r_{y=x}$):

4. Write your new points:

5. Graph both images in GSP
6. Save as your name under your account. Mrs. Schroeder will save it too!

Total Score:

Points:

Part I _____ / 60

HIGH SCHOOL EXAMINATION

Geometry Regents

Circles Unit Exam

ANSWER SHEET

Student .... Sex: □ Male □ Female Grade ....

Teacher .... School ....

Your answers to Part I should be recorded on this answer sheet.

Part I

Answer all 20 questions in this part.

1	9	17 ....
2	10	18 ....
3	11	19 ....
4	12	20 ....
5	13	
6	14	
7	15	
8	16	

Your answers for Parts II, III, and IV should be written in the test.

The declaration below should be signed when you have completed the examination.

I do hereby affirm, at the close of this examination, that I had no unlawful knowledge of the questions or answers prior to the examination and that I have neither given nor received assistance in answering any of the questions during the examination.

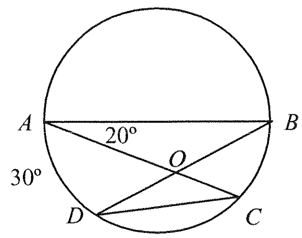
____

Signature

Unit Exam Geometry Honors

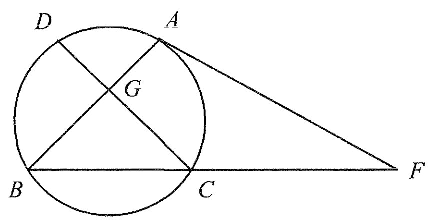
Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. A wheel from a motor has springs arranged as in the figure. Find m∠*DOC*.



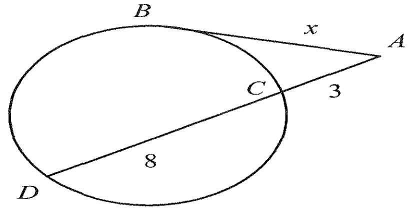
a. m∠*DOC* = 145°
b. m∠*DOC* = 150°
c. m∠*DOC* = 140°
d. m∠*DOC* = 130°

____ 2. Given m∠*AFB* = 25°, m∠*BAF* = 105°, and m∠*AGD* = 86°, find m(arc)*AC*.



a. m(arc)*AC* = 50°
b. m(arc)*AC* = 100°
c. m(arc)*AC* = 130°
d. m(arc)*AC* = 105°

____ 3. Find the value of *x*. Round to the nearest hundredth.

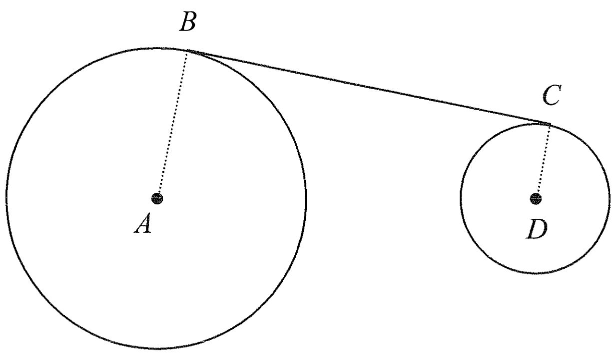


a. 3.32 c. 5.74
b. 4.90 d. 11.00

____ 4. Write the equation of a circle with center $M(7, -10)$ and radius 2.

a. $(x+10)^2 + (y-7)^2 = 4$
b. $(x-y)^2 + (7+10)^2 = 4$
c. $(x-7)^2 + (y+10)^2 = 4$
d. $(x-7)^2 + (y+10)^2 = 2$

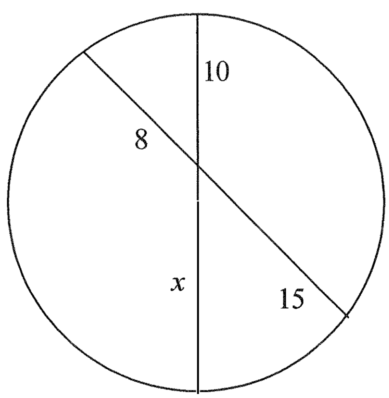
____ 5. $\overline{BC}$ is tangent to circle *A* at *B* and to circle *D* at *C* (not drawn to scale).
$AB = 7$, $BC = 18$, and $DC = 5$. Find *AD* to the nearest tenth.



a. 18.7 b. 18.1 c. 21.6 d. 19.3

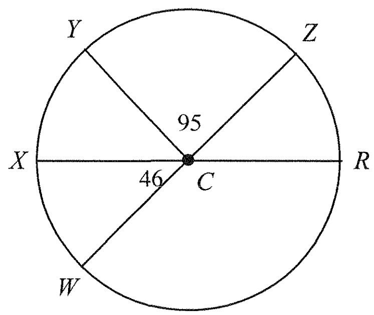
Find the value of *x*. If necessary, round your answer to the nearest tenth. The figure is not drawn to scale.

____ 6.



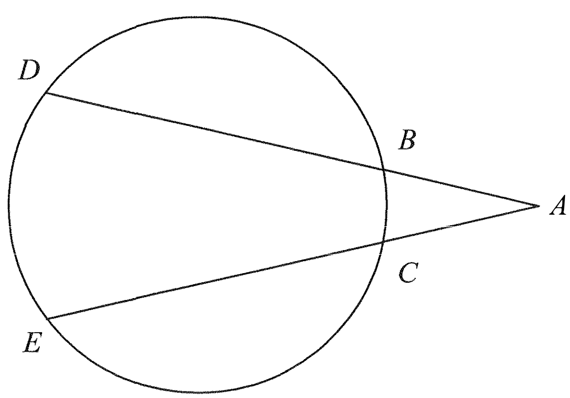
a. 18.8 b. 120 c. 5.3 d. 12

____ 7. $\overline{WZ}$ and $\overline{XR}$ are diameters. Find the measure of arc *ZWX*. (The figure is not drawn to scale.)



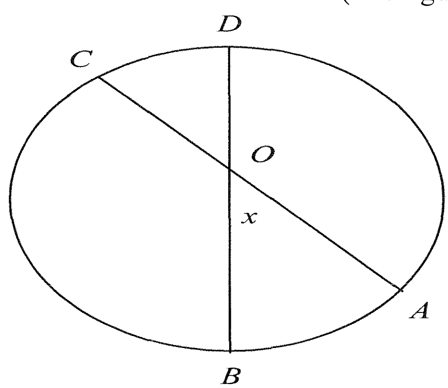
a. 226 b. 275 c. 39 d. 321

____8. *m*(arc *DE*) = 96 and *m*(arc *BC*) = 67. Find $m\angle A$.
(The figure is not drawn to scale.)



a. 14.5 b. 62.5 c. 81.5 d. 29

____ 9. Find the value of x for m(arc AB) = 46 and m(arc CD) = 25. (The figure is not drawn to scale.)



a. 35.5° b. 58.5° c. 71° d. 21°

Write the standard equation for the circle.

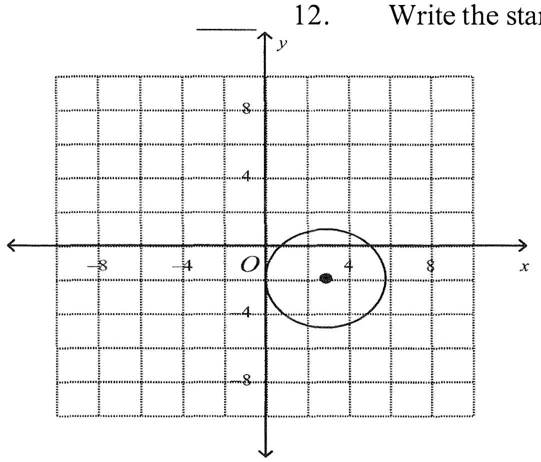
____ 10. center (–6, –8), that passes through (0, 0)

a. $(x-6)^2 + (y-8)^2 = 10$
b. $(x-6)^2 + (y-8)^2 = 196$
c. $(x+6)^2 + (y+8)^2 = 14$
d. $(x+6)^2 + (y+8)^2 = 100$

____ 11. Find the center and radius of the circle with equation $(x+9)^2 + (y+5)^2 = 64$.

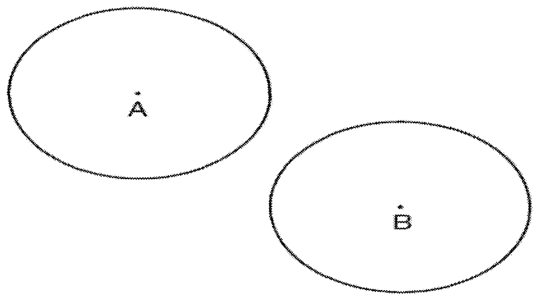
a. center (5, 9); $r = 8$
b. center (9, 5); $r = 64$
c. center (–9, –5); $r = 64$
d. center (–9, –5); $r = 8$

____ 12. Write the standard equation of the circle in the graph.



a. $(x+3)^2+(y-2)^2=9$
b. $(x-3)^2+(y+2)^2=9$
c. $(x-3)^2+(y+2)^2=18$
d. $(x+3)^2+(y-2)^2=18$

Part I
13.
In the diagram below, circle A and circle B are shown.



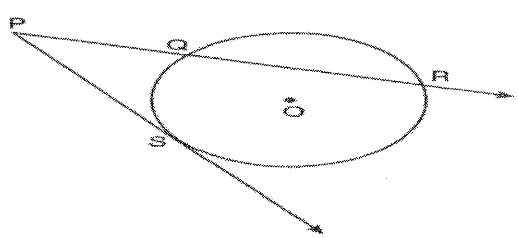
What is the total number of lines of tangency that are common to circle A and circle B?

(1) 1
(2) 2
(3) 3
(4) 4

14.
The diameter of a circle has endpoints at $(-2,3)$ and $(6,3)$. What is an equation of the circle?

(1) $(x-2)^2+(y-3)^2=16$
(2) $(x-2)^2+(y-3)^2=4$
(3) $(x+2)^2+(y+3)^2=16$
(4) $(x+2)^2+(y+3)^2=4$

15.
In the diagram below, $\overline{PS}$ is a tangent to circle O at point S, $\overline{PQR}$ is a secant, $PS=x$, $PQ=3$, and $PR=x+18$.



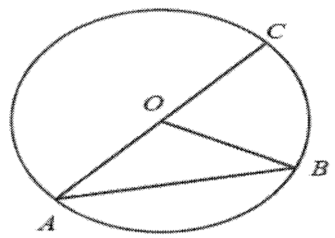
(Not drawn to scale)

What is the length of $\overline{PS}$?

(1) 6
(2) 9
(3) 3
(4) 27

16.

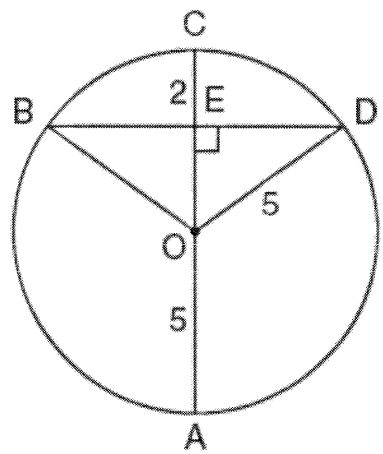
Given: In circle O, $m\widehat{BAC} = 290$. Find $m\angle B$.



[A] 20.5 [B] 41 [C] 35 [D] 17.5

17.

In the diagram below, circle O has a radius of 5, and $CE = 2$. Diameter $\overline{AC}$ is perpendicular to chord $\overline{BD}$ at E.



What is the length of $\overline{BD}$?

(1) 12
(2) 10
(3) 8
(4) 4

18.

What are the center and radius of a circle whose equation is $(x - A)^2 + (y - B)^2 = C$?

(1) center = (A,B); radius = C

(2) center = $(-A,-B)$; radius = C

(3) center = (A,B); radius = $\sqrt{C}$

(4) center = $(-A,-B)$; radius = $\sqrt{C}$

19.

The endpoints of $\overline{AB}$ are $A(3,2)$ and $B(7,1)$. If $\overline{A''B''}$ is the result of the transformation of $\overline{AB}$ under $D_2 \circ T_{-4,3}$ what are the coordinates of A'' and B''?

(1) $A''(-2,10)$ and $B''(6,8)$

(2) $A''(-1,5)$ and $B''(3,4)$

(3) $A''(2,7)$ and $B''(10,5)$

(4) $A''(14,-2)$ and $B''(22,-4)$

20.

What is the slope of a line perpendicular to the line whose equation is $5x + 3y = 8$?

(1) $\frac{5}{3}$

(2) $\frac{3}{5}$

(3) $-\frac{3}{5}$

(4) $-\frac{5}{3}$

Part II
Answer all questions in this part. Each correct answer will receive 3 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit.

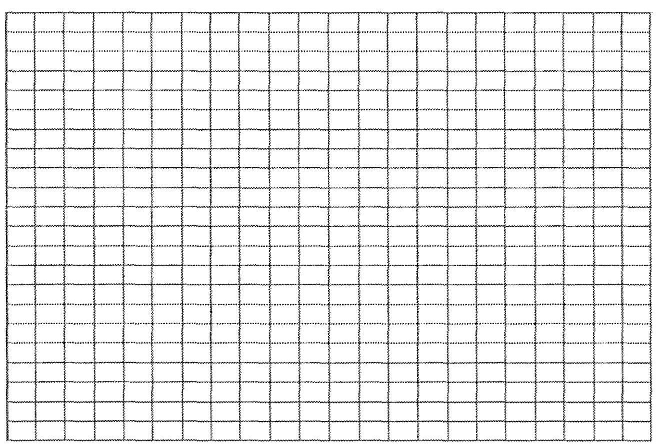
1. Write the equation of each circle.

⊙*J* with center *J* (2, 2) and radius 16

2. Write the equation of each circle.

⊙*J* with center *at the origin* and radius 3

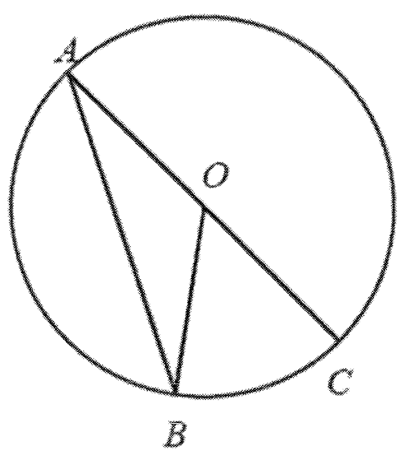
3. Graph $x^2 + y^2 = 4$.



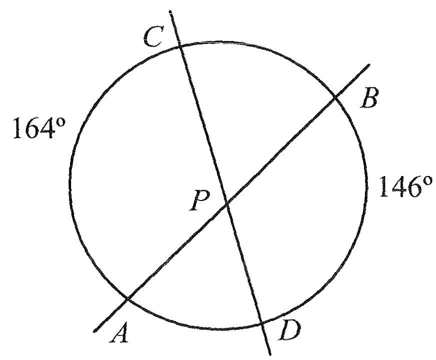
Part III.
Answer all questions in this part. Each correct answer will receive 4 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit.

1.

Given: $\overline{AC}$ is a diameter of circle O and $m\angle BAC = 27$. Find $m\angle ABO$.

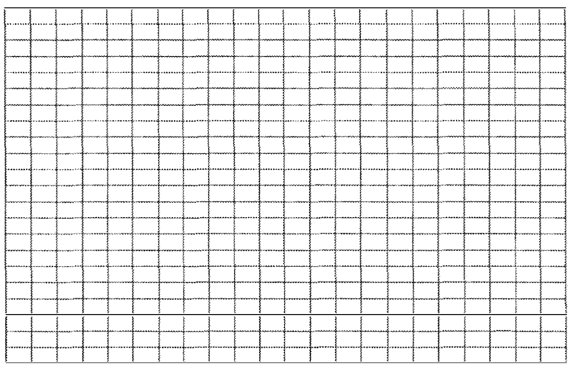


2. Find $m\angle BPD$.



3. Write the equation of a circle.
⊙K that passes through $J(4, 6)$ and has center $K(1, 1)$ (round to the nearest tenth if necessary)

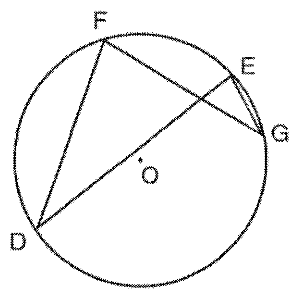
4. Graph $(x-5)^2 + (y+5)^2 = 9$.



Part IV.
Answer all questions in this part. Each correct answer will receive 5 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit.

1.

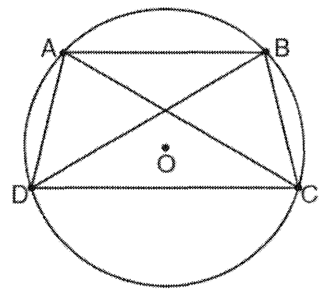
In the diagram below of circle O, chords $\overline{DF}$, $\overline{DE}$, $\overline{FG}$, and $\overline{EG}$ are drawn such that $m\overset{\frown}{DF} : m\overset{\frown}{FE} : m\overset{\frown}{EG} : m\overset{\frown}{GD} = 5 : 2 : 1 : 7$. Identify one pair of inscribed angles that are congruent to each other and give their measure.



2.

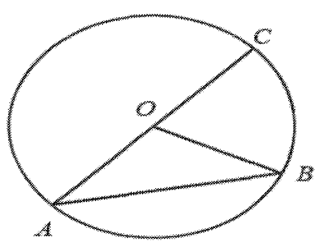
In the diagram below, quadrilateral $ABCD$ is inscribed in circle O, $\overline{AB} \parallel \overline{DC}$, and diagonals $\overline{AC}$ and $\overline{BD}$ are drawn.

Prove that $\triangle ACD \cong \triangle BDC$.



3.

Given: In circle O, $m\widehat{BAC} = 290$. Find $m\angle B$.



Appendix

Total Score:

Points:

Part I _____ / 60

The University of the State of New York

HIGH SCHOOL EXAMINATION

Geometry Regents

Transformations Unit Exam

ANSWER SHEET

Student .... Sex: □ Male □ Female Grade ....

Teacher .... School ....

Your answers to Part I should be recorded on this answer sheet.

Part I
Answer all 20 questions in this part.

1	9	17 ....
2	10	18 ....
3	11	19 ....
4	12	20 ....
5	13	
6	14	
7	15	
8	16	

Your answers for Parts II, III, and IV should be written in the test.
The declaration below should be signed when you have completed the examination.

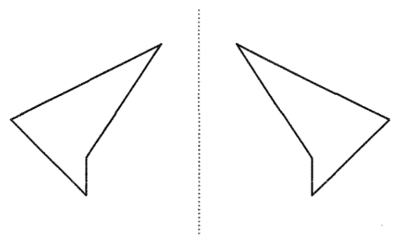
I do hereby affirm, at the close of this examination, that I had no unlawful knowledge of the questions or answers prior to the examination and that I have neither given nor received assistance in answering any of the questions during the examination.

____
Signature

Unit Exam

Multiple Choice
Identify the choice that best completes the statement or answers the question.

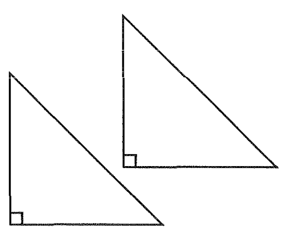
____ 1. Tell whether the transformation appears to be a reflection. Explain.



a. Yes; the image appears to be flipped across a line.
b. No; the image does not appear to be flipped.

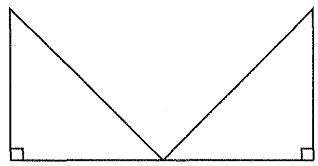
____ 2. Reflect a figure with vertices $A(1, 2)$, $B(3, 6)$, $C(-1, 2)$, and $D(-2, -2)$ across the x-axis. Find the coordinates of the new image.
a. $A'(-1, -2)$, $B'(-3, -6)$, $C'(1, -2)$, and $D'(2, 2)$
b. $A'(1, -2)$, $B'(3, -6)$, $C'(-1, -2)$, and $D'(-2, 2)$
c. $A'(-1, 2)$, $B'(-3, 6)$, $C'(1, -2)$, and $D'(2, -2)$
d. $A'(1, 2)$, $B'(3, 6)$, $C'(-1, 2)$, and $D'(-2, -2)$

____ 3. Tell whether the transformation appears to be a translation. Explain.



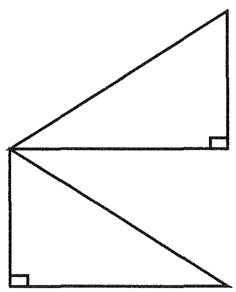
a. Yes; all of the points have moved the same distance in the same direction.
b. No; not all of the points have moved the same distance.

____ 4. Tell whether the transformation appears to be a translation. Explain.



a. Yes; all of the points have moved the same distance in the same direction.
b. No; not all of the points have moved the same distance.

____ 5. Tell whether the transformation appears to be a translation. Explain.



a. Yes; all of the points have moved the same distance in the same direction.
b. No; not all of the points have moved the same distance.

____ 6. Translate the triangle with vertices $A(3, 4)$, $B(2, -1)$, and $C(4, 12)$ along the $T_{-1,3}$. Find the coordinates of the new image.
a. $A'(2, 7)$, $B'(1, 2)$, and $C'(3, 15)$
b. $A'(-3, 12)$, $B'(-2, -3)$, and $C'(-4, 36)$
c. $A'(4, 7)$, $B'(3, -2)$, and $C'(5, 15)$
d. $A'(6, 3)$, $B'(5, -2)$, and $C'(7, 11)$

____ 7. Tell whether the transformation appears to be a rotation. Explain.

a. No; the figure appears to be flipped.
b. Yes; the figure appears to be turned around a point.

____ 8. The point G(4,2) reflected across the line y= -2. Find the coordinates of the image G'.

a. (-2,4)
b. (-6,4)
c. (-4,-2)
d. (4,-6)

____ 9.

The coordinates of $\triangle JRB$ are $J(1,-2)$, $R(-3,6)$, and $B(4,5)$. What are the coordinates of the vertices of its image after the transformation $T_{2,-1} \circ r_{y-\text{axis}}$?

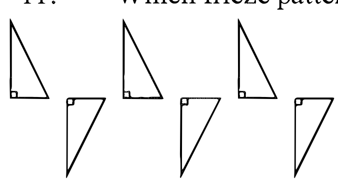
1) $(3,1),(-1,-7),(6,-6)$
2) $(3,-3),(-1,5),(6,4)$
3) $(1,-3),(5,5),(-2,4)$
4) $(-1,-2),(3,6),(-4,5)$

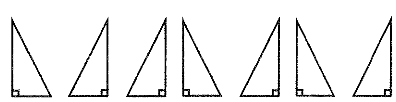
____ 10.

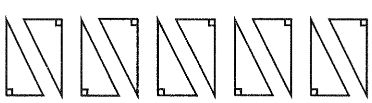
What are the coordinates of point A', the image of point $A(-4,1)$ after the composite transformation $R_{90°} \circ r_{y=x}$ where the origin is the center of rotation?

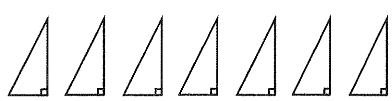
1) $(-1,-4)$
2) $(-4,-1)$
3) $(1,4)$
4) $(4,1)$

____ 11. Which frieze pattern has glide reflection symmetry?

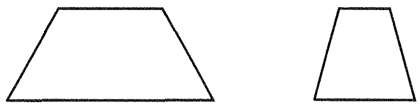
a.


c.


b.


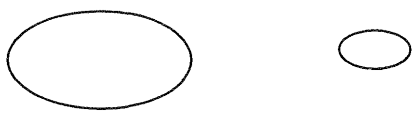
d.


____ 12. Tell whether the transformation appears to be a dilation. Explain.



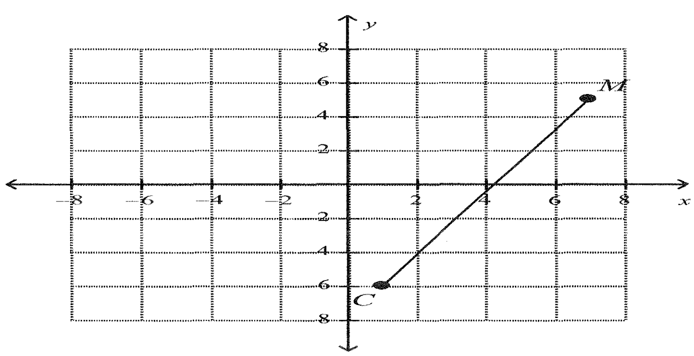
a. Yes; the figures are similar, and the image is not turned or flipped.
b. No; the figures are not similar.

____ 13. Tell whether the transformation appears to be a dilation. Explain.



a. Yes; the figures are similar, and the image is not turned or flipped.
b. No; the figures are not similar.

____ 14. Find the coordinates of the midpoint of $\overline{CM}$ with endpoints $C(1, -6)$ and $M(7, 5)$.

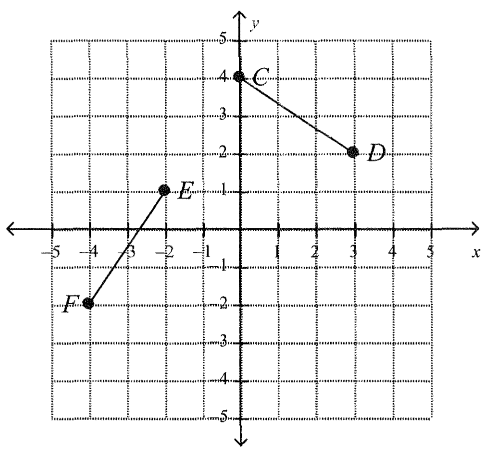


a. $(3, -1)$
b. $(8, -1)$
c. $(4, -\frac{1}{2})$
d. $(4\frac{1}{2}, \frac{1}{2})$

____ 15. M is the midpoint of $\overline{AN}$, A has coordinates (–6, –6), and M has coordinates (1, 2). Find the coordinates of N.

a. (8, 10)
c. $(-2\frac{1}{2}, -2)$
b. (–5, –4)
d. $(8\frac{1}{2}, 9\frac{1}{2})$

____ 16. Find CD and EF. Then determine if $\overline{CD} \cong \overline{EF}$.



a. $CD = \sqrt{13}$, $EF = \sqrt{13}$, $\overline{CD} \cong \overline{EF}$
b. $CD = \sqrt{5}$, $EF = \sqrt{13}$, $\overline{CD} \ncong \overline{EF}$
c. $CD = \sqrt{13}$, $EF = 3\sqrt{5}$, $\overline{CD} \ncong \overline{EF}$
d. $CD = \sqrt{5}$, $EF = \sqrt{5}$, $\overline{CD} \cong \overline{EF}$

____ 17. Use the Distance Formula and the Pythagorean Theorem to find the distance, to the nearest tenth, from $T(4, -2)$ to $U(-2, 3)$.

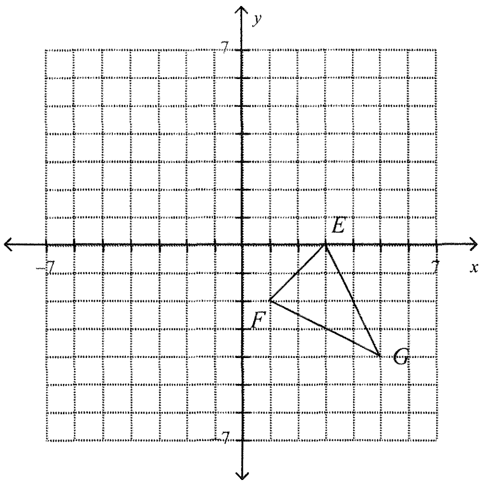
a. –1.0 units
c. 0.0 units
b. 3.4 units
d. 7.8 units

____ 18.

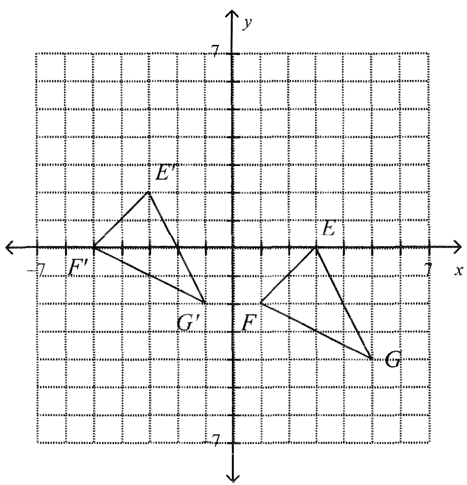
What is the image of point $A(4,2)$ after the composition of transformations defined by $R_{90^\circ} \circ r_{y=x}$?

1) $(-4,2)$
2) $(4,-2)$
3) $(-4,-2)$
4) $(2,-4)$

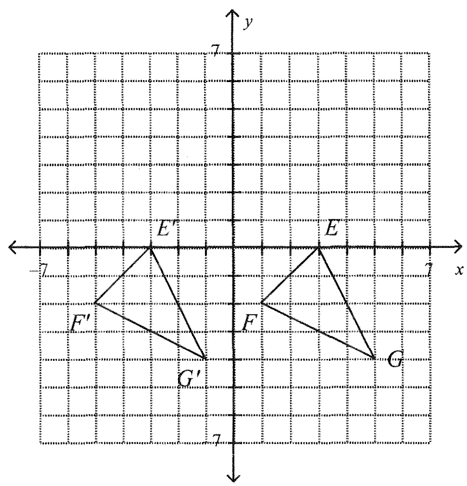
_____ 19. Find the coordinates for the image of ΔEFG after the translation $(x, y) \rightarrow (x - 6, y + 2)$. Draw the image.



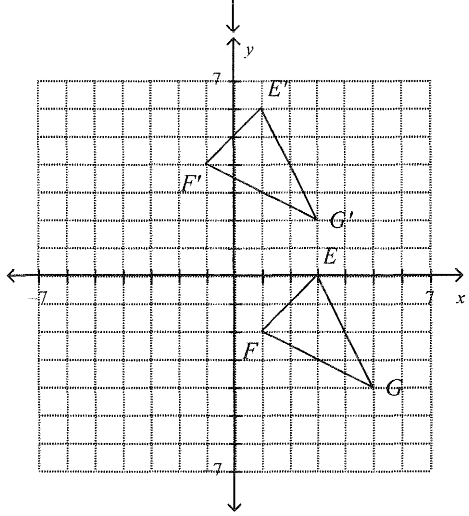
a.



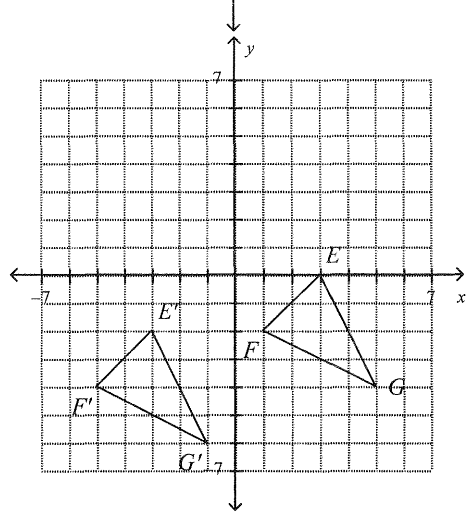
c.



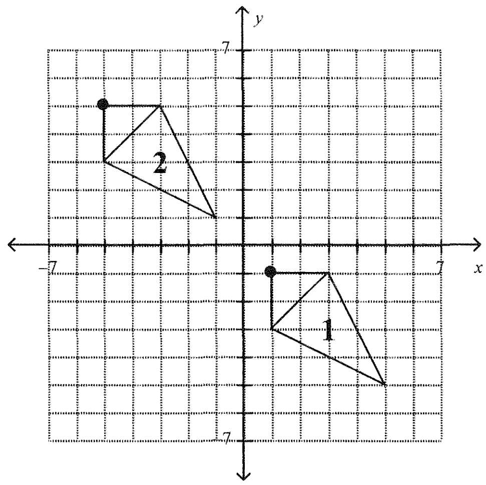
b.



d.



____ 20. An animated film artist creates a simple scene by translating a kite against a still background. Write a rule for the translation of kite 1 to kite 2.



a. $(x, y) \rightarrow (x - 6, y + 6)$
b. $(x, y) \rightarrow (x + 6, y - 6)$
c. $(x, y) \rightarrow (x - 2, y + 2)$
d. $(x, y) \rightarrow (x + 2, y - 2)$

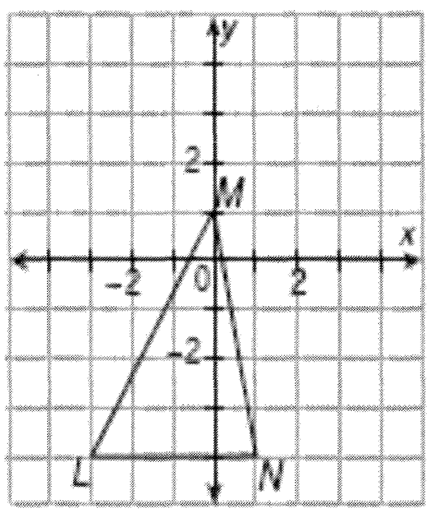
Part II

Answer all questions in this part. Each correct answer is worth 3 points (credits). Clearly indicate the necessary step, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 point (credit).

1. Find the coordinates of the image of $F(-1, 3)$ after the translation $(x, y) \rightarrow (x + 2, y - 5)$.

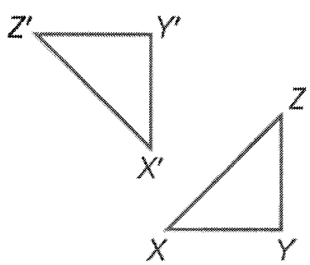
2.

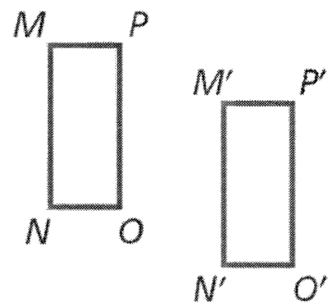
ΔLMN is reflected across the line $y = x$ and then reflected across the y-axis. What are the coordinates of the final image of ΔLMN?

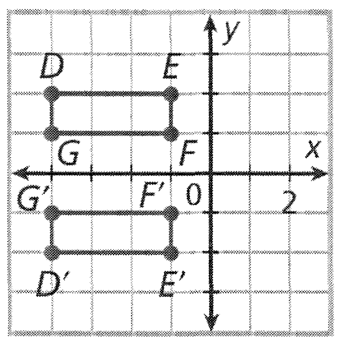


3. **Identify each picture:**

a. ____________ b. ___________ c. ____________







Part III

Answer all questions in this part. Each correct answer is worth 4 points (credits). Clearly indicate the necessary step, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 point (credit).

1.

$R(-1, 2)$, $S(2, 1)$, $T(3, -1)$;

This composition may be written as $D_{\frac{1}{2}} \circ R_{0,180^\circ}$.

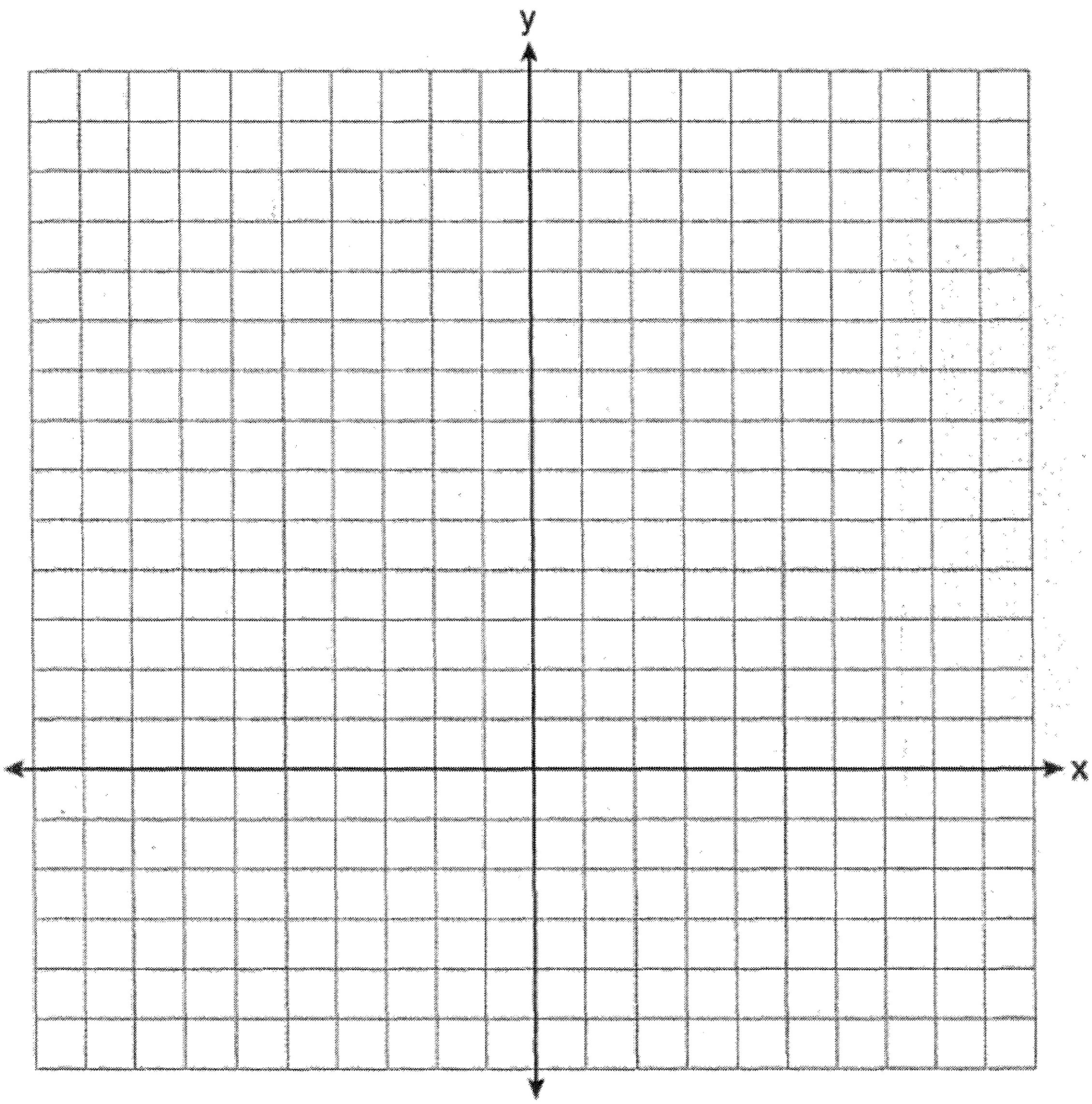
State the coordinates of R'', S'', and T.''

Part IV
Answer all questions in this part. Each correct answer is worth 5 points (credits). Clearly indicate the necessary step, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 point (credit).

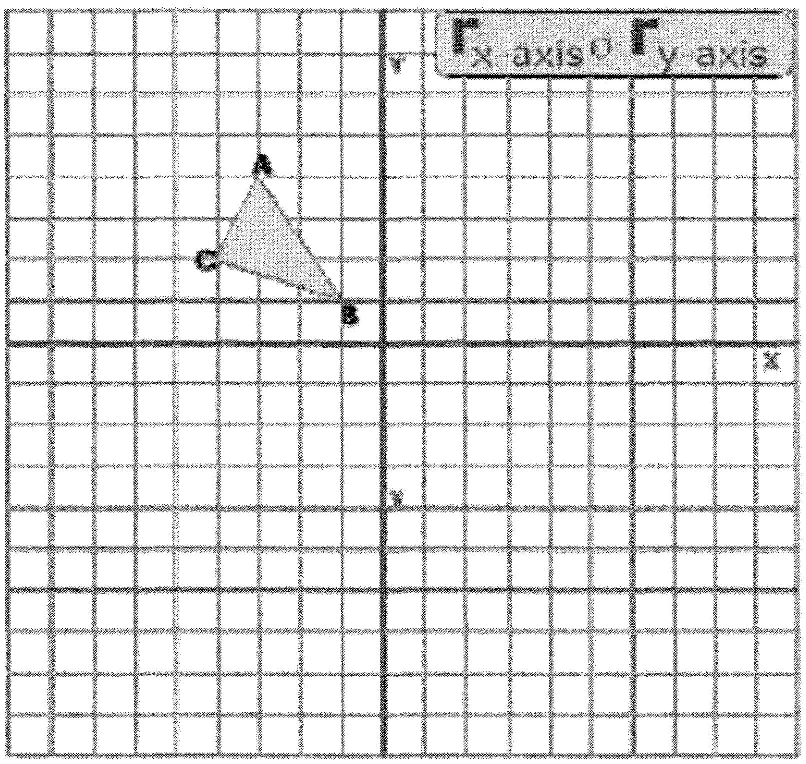
1. Graph Each figure then identify the transformation.

Traignle: X(1,1), Y(3,1) and Z (3,4)

Triangle: X^1(-1,-1), Y^1(-3,-1) and Z^1(-3,-4)



2. Make a Chart for A(-3, 4), B(-1,-1), and C(-4,2) after the composition.



3.

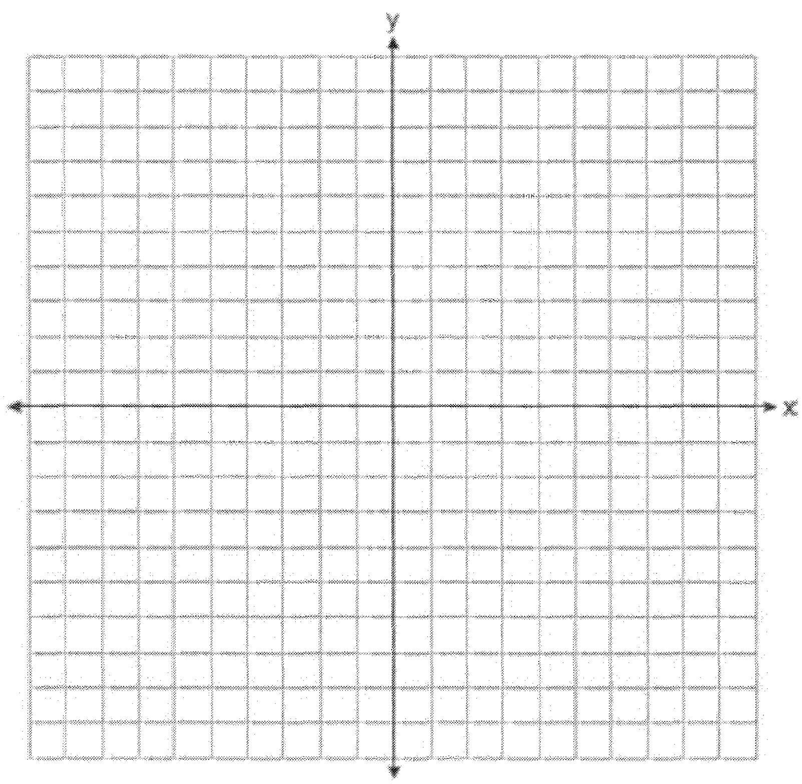
The coordinates of the vertices of $\triangle ABC$ are $A(1,6)$, $B(2,9)$, and $C(7,10)$.

a On the graph below, draw and label $\triangle ABC$.

b Graph and state the coordinates of $\triangle A'B'C'$, the image of $\triangle ABC$ after a reflection over the line $y = x$.

c Graph and state the coordinates of $\triangle A''B''C''$, the image of $\triangle A'B'C'$ after a reflection in the x-axis.

d Graph and state the coordinates of $\triangle A'''B'''C'''$, the image of $\triangle A''B''C''$ after the transformation $(x,y) \rightarrow (x-5, y+3)$.



Mrs. Schroeder's Research Survey

You can leave a question blank if you do not want to answer it.

EDI@SON
School of Business, Finance and Entrepreneurship at Edison

1. Which class period are you in: 1st or 5th?

2. Which unit did you enjoy more: Circles or Transformations?

3. Which unit was there more technology used throughout the unit: Circles or Transformations?

4. I felt happy when I knew my class was going to the computer lab:

Strongly Agree Agree Disagree Strongly Disagree

5. I felt happy when I went up to the SMART Board:

Strongly Agree Agree Disagree Strongly Disagree

6. I felt that I learned more when my class went to the computer lab during math lab time:

Strongly Agree Agree Disagree Strongly Disagree

7. I felt I learned more when I got to use the SMART Board myself:

Strongly Agree Agree Disagree Strongly Disagree

8. I completed my entire class work assignment when my class was in the computer lab:

Strongly Agree Agree Disagree Strongly Disagree

9. I read the explanations that the computer programs provided me and it allowed me to understand the material.

Strongly Agree Agree Disagree Strongly Disagree

10. I believe the technology in this mathematics classroom resulted in my performance in mathematics to increase:

Strongly Agree Agree Disagree Strongly Disagree

11. I feel more motivated to do better in my mathematics class when technology is used in the classroom:

Strongly Agree Agree Disagree Strongly Disagree

12. I have positive attitudes and perceptions towards mathematics class when technology is used in the classroom:

Strongly Agree Agree Disagree Strongly Disagree

Student Test Score Data

Period 1 Exam Scores

Circle Unit Exam	Transformation Unit Exam
72	58
58	87
95	81
77	92
75	96
66	78
46	91
69	69
69.75	81.5

Period 5 Exam Scores

Circle Unit Exam	Transformation Unit Exam
48	84
85	83
59	51
98	93
72	84
63	94
78	78
83	55
73.25	77.75

Student Survey Results: 5th Period

1. Which class period are you in:	1st: 0	5th: 8
2. Which unit did you enjoy more:	Circles: 5	Transformations: 3
3. Which unit was there more technology used throughout the unit:	Circles: 8	Transformations: 0

Question	Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)	Average
4. I felt happy when I knew my class was going to the computer lab:	0	0	5	3	3.78
5.I felt happy when I went up to the SMART Board:	0	1	2	5	3.50
6. I felt that I learned more when my class went to the computer lab during math lab time:	0	6	1	1	2.38
7. I felt I learned more when I got to use the SMART Board myself	0	4	2	2	2.75
8. I completed my entire class work assignment when my class was in the computer lab:	1	3	3	1	2.50
9. I read the explanations that the computer programs provided me and it allowed me to understand the material.	0	2	5	1	2.88
10. I believe the technology in this mathematics classroom resulted in my performance in mathematics to increase:	0	3	5	0	2.63
11. I feel more motivated to do better in my mathematics class when technology is used in the classroom:	0	1	6	1	3
12. I have positive attitudes and perceptions towards mathematics class when technology is used in the classroom:	0	0	3	5	3.63

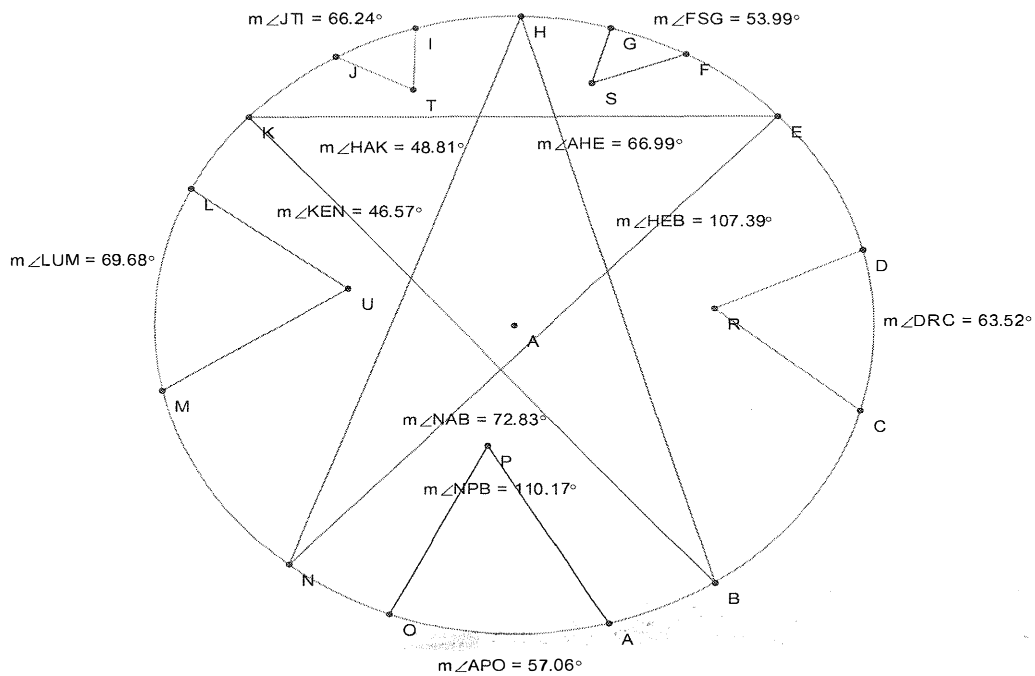
Appendix

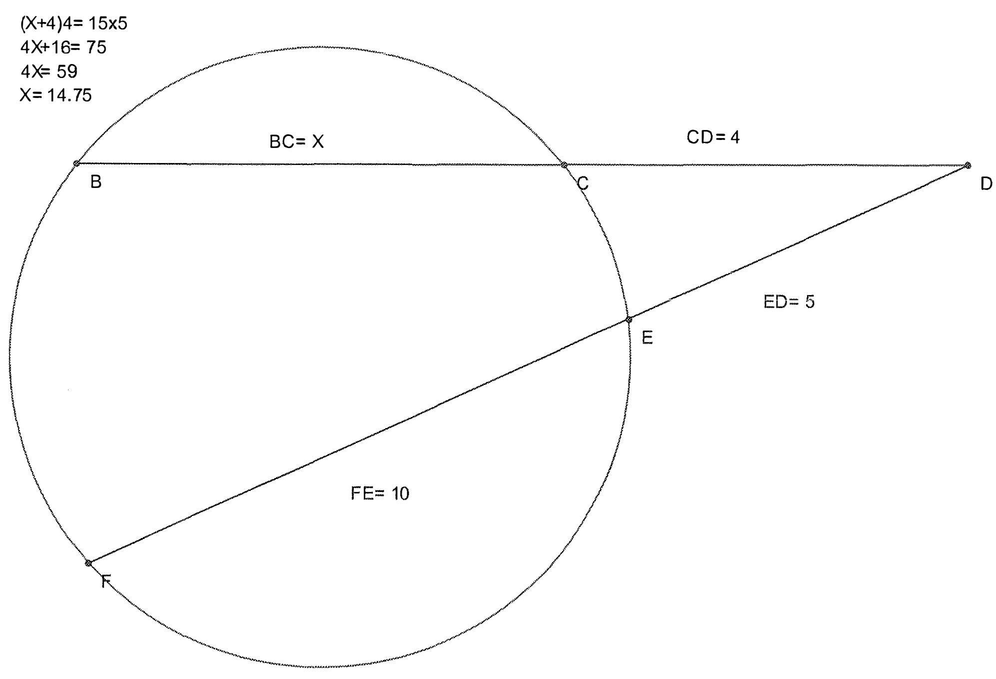
Student Survey Results: 1st Period

1. Which class period are you in:	1st: 8	5th: 0
2. Which unit did you enjoy more:	Circles: 1	Transformations: 7
3. Which unit was there more technology used throughout the unit:	Circles: 0	Transformations: 8

Question	Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)	Average
4. I felt happy when I knew my class was going to the computer lab:	0	0	6	2	3.25
5.I felt happy when I went up to the SMART Board:	0	0	4	4	3.50
6. I felt that I learned more when my class went to the computer lab during math lab time:	0	1	4	2	2.75
7. I felt I learned more when I got to use the SMART Board myself	0	1	2	5	3.50
8. I completed my entire class work assignment when my class was in the computer lab:	0	2	3	3	3.13
9. I read the explanations that the computer programs provided me and it allowed me to understand the material.	0	0	6	2	3.25
10. I believe the technology in this mathematics classroom resulted in my performance in mathematics to increase:	0	1	5	2	3.13
11. I feel more motivated to do better in my mathematics class when technology is used in the classroom:	0	0	4	4	3.50
12. I have positive attitudes and perceptions towards mathematics class when technology is used in the classroom:	0	0	6	2	3.25

Student Work: Circles





Student Work: Transformations