Eastern West Virginia Community and Technical College
COURSE ASSESSMENT REPORT

Course Title and Number: MTH 135 College Algebra	**Academic Term and Year of Assessment Activity (Ex: Fall, 2014)** Spring 2015
Report Submitted By: Andrea Williams	**Number of Students Assessed:** 26
Date Report Submitted: May 20, 2015	**Number of Sections Included:** 2
Course Delivery Format (list all modalities used in sections assessed. Ex: web based, VDL, traditional section, hybrid course, etc.): Both traditional sections, one of adults at Eastern's main campus and one of early entrance students at Petersburg High School	

Course Role in the Curriculum

Provide a description of the role the course serves in the curriculum (i.e. general education requirement, program technical core, restricted elective, etc.). Note all as appropriate.

MTH 135 is a general education course taken primarily by students seeking an Associate of Science degree or by those who will transfer to a four-year program of study requiring College Algebra. At Eastern, MTH 123 Intermediate Algebra or satisfactory placement scores are prerequisites to MTH 135.

Assessment Methods

Provide a description of the assessment process used. Include description of instrument and performance standards in description. Note all methods.

Final exam questions are used as a basis for this assessment. The two sections were given different exams via different modalities, but the instructors collaborated prior to the exam about what questions would be included for purposes of this assessment. For the adult section, the final was a paper exam given in two parts on two days. Students were allowed to use a graphing calculator and a 3x5 index card of notes they created. Students were given partial credit based on the work they showed on their test paper, but for purposes of this analysis, only questions receiving full credit are considered correct. Students were given an optional (for extra credit) review assignment two weeks prior to the final exam with similar (but not the same) questions.

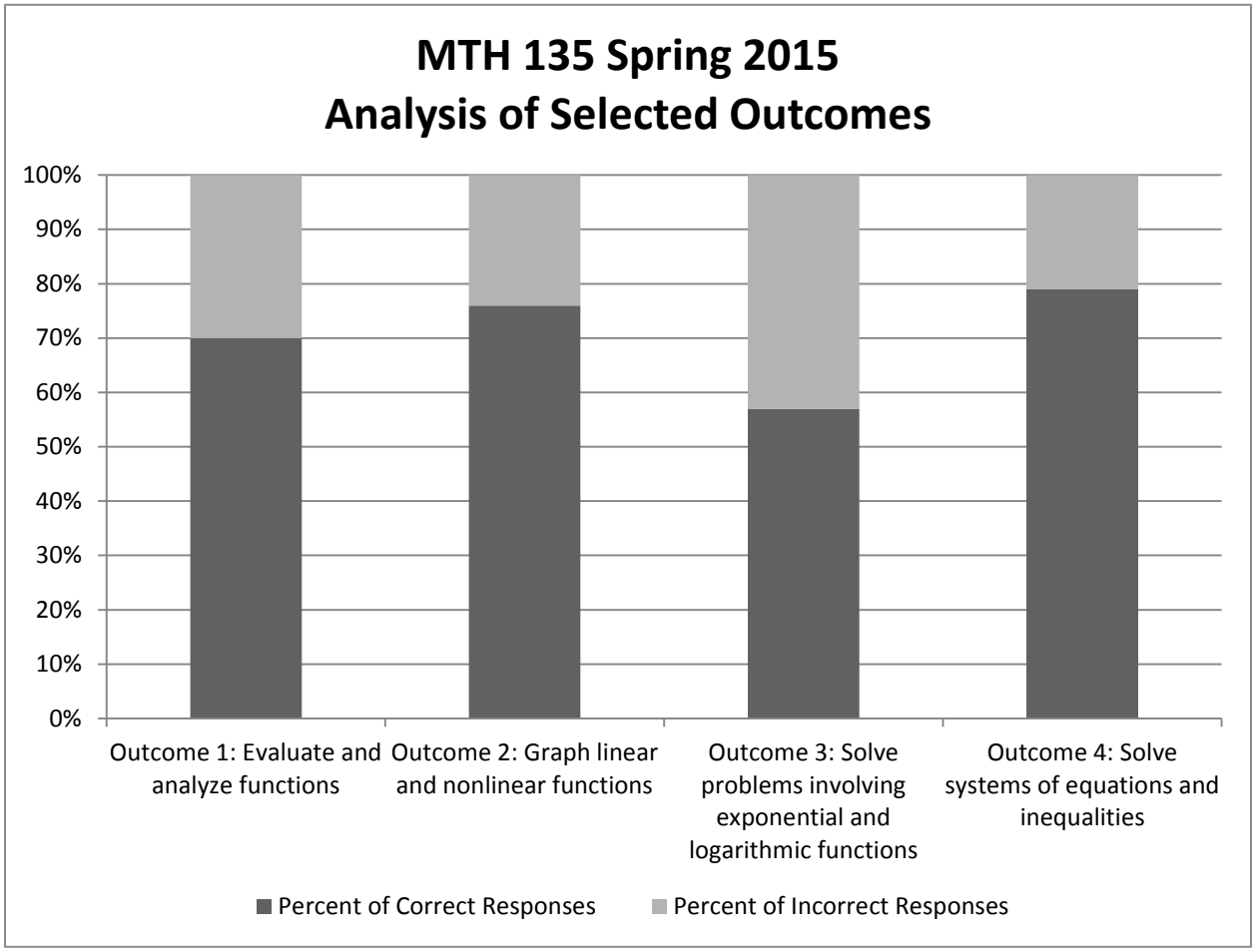
For the high school section, the exam was given through the online homework and assessment product Pearson's MyMathLab (as were all of the unit tests during the semester) but was proctored in class.

Multiple questions are included in each outcome for analysis. A minimum satisfactory percent of correct responses for each outcome is 75%. Those failing to meet the standard are reviewed on an outcome-by-outcome basis.

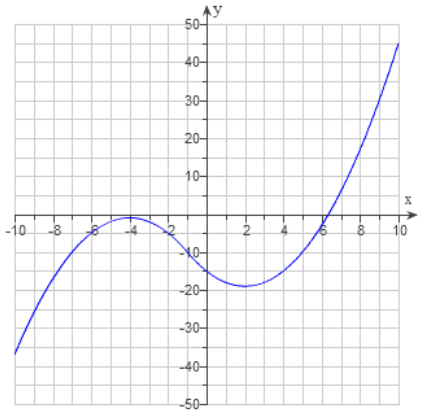
Assessment Results

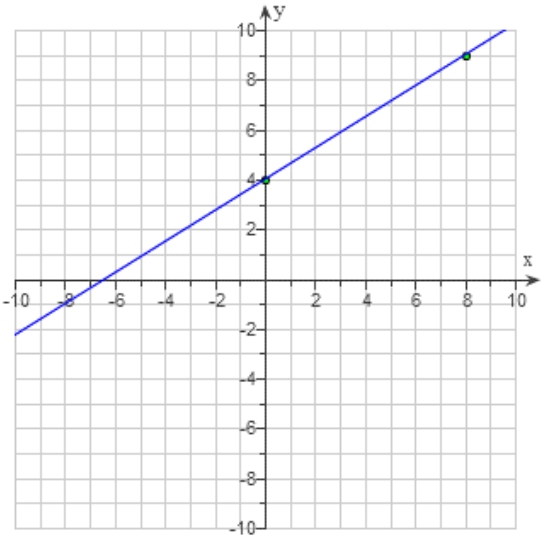
Provide a summary of results including tables/charts. Incorporate information from previous assessments as appropriate. Append additional pages if necessary. If appending, include notation in box to "See attached".

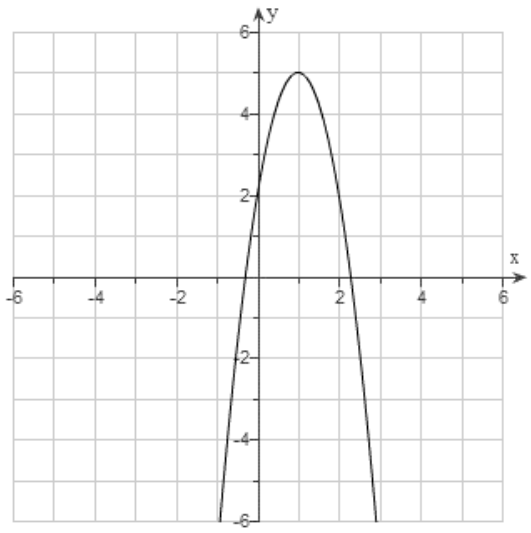
Four outcomes were analyzed, and two out of the four met the 75% correct criterion, which shows improvement over the previous course assessment. More details about the outcomes and the assessed questions are included in the action plan.



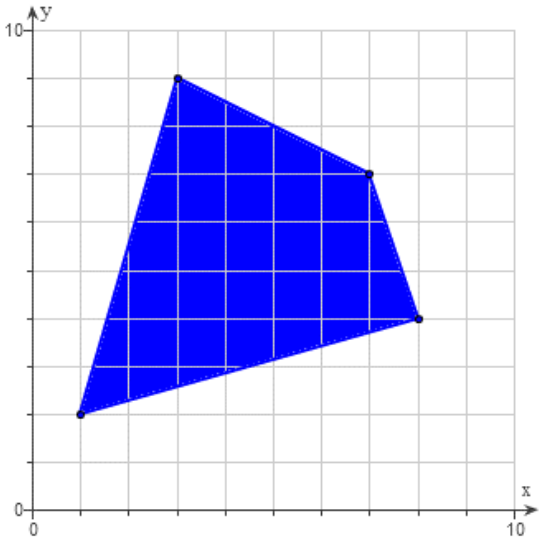
Course Level Assessment Summary of Outcomes, Indicators and Results Course Title and Number: MTH 135 – College Algebra – Spring 2015 Number of students in assessment sample = 26 Number of Sections in Assessment = 2 Add additional rows to table if necessary				
Learning Outcomes (Insert learning outcomes assessed during this cycle)	**Indicator (Insert indicators used for each outcome: exam question, scoring rubric, etc. Be specific)**	**Percent of Correct Responses +**	**Percent of Incorrect Responses**	**Performance Standard Met (75%)* (yes or no)**
Outcome 1: Evaluate and	**1.1.** Circle the set or sets to which the number 8.9 belongs.	70%	30%	No

analyze functions	a. natural numbers b. whole numbers c. integers d. rational numbers e. irrational numbers f. real numbers **1.5.** Determine whether the relation is a function: {(3,2),(24,-8)(43,2),(3,5),(58,5)}. **1.6.** Evaluate $g(x) = \frac{5}{3-5x}$ for $x = 1$. **1.7.** Find the domain of $g(x) = \frac{5}{3-5x}$. Write your answer in set-builder notation. **1.8.** Use the graph of *f* to determine intervals where *f* is decreasing and where *f* is increasing.  **2.15.** If $f(x) = x^2 - 20$ and $g(x) = 2 - x$, find $(fg)(-3)$. **2.16.** If $f(x) = \sqrt{5-x}$ and $g(x) = x^2 + 3$, find $(g \circ f)(x)$. **2.17.** Find the inverse of the one-to-one function $f(x) = 2x + 1$.			
Outcome 2: Graph linear and nonlinear functions	**1.2.** Find the distance between (-20, -8) and (-23, -17), rounded to the nearest hundredth. **1.3.** Find the midpoint of the segment with endpoints (5, -3) and (-1, 0). **1.4.** Graph the circle $(x-4)^2 + (y+2)^2 = 4$. Give the center and the radius.	76%	24%	Yes

	1.9. Find an equation of the line containing the points (-7, -9) and (-1, -8). Write your answer in slope-intercept form. **1.10.** Write an equation for the line shown in the graph. Write your answer in slope-intercept form.  **1.11.** Find the intercepts of $7x - 5y = 35$ and then use them to graph the equation. **1.12.** Write an equation of the line satisfying the following conditions: horizontal, passing through (-3,3). **1.14.** Find $f(0)$ if $f(x) = \begin{cases} x - 9, \text{ if } x < 6 \\ 4 - x, \text{ if } x \geq 6 \end{cases}$. **2.1.** Use the graph of f to write its formula as $f(x) = a(x - h)^2 + k$.			

	 **2.5.** Graph $f(x) = \frac{1}{2}(x+2)^2$ using transformations. List at least 3 points on the final graph.			
Outcome 3: Solve problems involving exponential and logarithmic functions	**2.18.** There are initially 2500 bacteria in a sample, and this sample doubles in size every hour. Find values for C and a so that $f(x) = Ca^x$ gives the number of bacteria after x hours. **2.19.** Use the formula $A = Pe^{rt}$ to determine the final value of \$960 invested at 3% compounded continuously for 15 years. **2.20.** Find the domain of $f(x) = \ln(5-x)$. Write your answer in interval notation. **2.21.** Solve $\log_6(6x-6) = 4$. **2.22.** Use the properties of logarithms to write $6\ln x - \frac{1}{8}\ln y$ as a single logarithm. **2.23.** Find $\log_5 70$ rounded to four decimal places. **2.24.** Solve $4(1.21)^x + 2 = 13$. Round your answer to the nearest thousandth. **2.25.** One method to determine the time since an animal died is to estimate the percentage of carbon-14 remaining in its bones. The percent P in decimal form of carbon-14 remaining after x years is given by $P(x) = e^{-0.000121x}$. Approximate (to the nearest whole year) the	57%	43%	No

	age of a fossil if there is 70% of carbon-14 remaining.			
Outcome 4: Solve systems of equations and inequalities	**1.17.** Solve the system of equations by using the substitution method. $6x - 2y = 4$ $x + y = 0$ **1.18.** Solve by the elimination method. $7x - y = 34$ $x + 8y = 70$ **1.19.** Solve the nonlinear system of equations. $x^2 + y = 21$ $4x + y = 0$ **1.20.** Write the system as an augmented matrix. Then solve the system of equations using row-echelon form and backward substitution. $x + 2y + 4z = 8$ $-x + 3y + 2z = -5$ $x + y - 5z = -16$ **1.21.** Evaluate $2\begin{bmatrix}-2 & 3\\ -6 & 7\end{bmatrix} - 3\begin{bmatrix}0 & 0\\ -8 & -7\end{bmatrix}$. **1.22.** Solve the following system of equations by using $X = A^{-1}B$. $-3x - y + 8z = 22$ $-4y + 6z = 10$ $5x + 6y + 6z = 30$ **1.23.** Solve the system of equations by using Cramer's rule. $8x + 4y = 1$ $2x + 5y = 13$ **1.24.** Graph the solution set to the system of inequalities. Give a point in the solution set. $x - 2y \leq 2$ $x + y \leq 0$ **1.25.** The graph shows a region of feasible solutions. Find the maximum and minimum values of the expression $4x + 8y$.	79%	21%	Yes

* Please note if using a different minimum performance standard.
+See Attachment 1 for further analysis of performance by question and by section.

Conclusions **Provide a brief summary of conclusions derived based on analysis of data. Append additional pages if necessary. If appending, include notation in box to "See attached".**
This course assessment shows a good deal of improvement over the previous one, with two of the four assessed outcomes met and a third outcome only missing the criterion by 5%. Overall, the high school section performed better than the adult section with each of the outcomes, but historically this has always been the case due to the criteria for placement. Recent changes to high school curriculum will be considered in future assessments of this course. Changes since the previous assessment will continue to be implemented along with further emphasis on weaker topics as discussed below in the action plan.

Previous Assessment Reports and Results **Date of Previous Assessment: Spring 2013** **List of Outcomes Not Met: Solve systems of linear equations using substitution, elimination, or matrix methods; form composite functions; solve exponential equations; analyze series** **Summary of Actions Taken to Address Unmet Learning Outcomes: Append additional pages if necessary. If appending, include notation in box to "See attached".**
The major change needed for MTH 135 as discussed in the Spring 2013 course assessment was editing the Master Course Record to eliminate some outcomes, which would allow the remaining outcomes to be covered more in-depth and at a more reasonable pace. That has since been done, and the content can now be comfortably covered within the allotted class time, while the students are still learning the same material as they would by taking a similar course at any other institution. Based on the results of this assessment, this seems to be have been an effective change to the course. Solve systems of linear equations using substitution, elimination, or matrix methods: More emphasis has

been placed on using the various matrix methods for solving systems of equations (for which the graphing calculator does most of the work) as opposed to the symbolic methods which are more time consuming and more susceptible to errors.

Form composite functions: More examples have been added when this topic is covered in class.

Solve exponential equations: More time was allotted for this and other exponential topics due to the revision of the Master Course Record as discussed above.

Analyze series: This was one topic that was eliminated with the revision of the Master Course Record. Students that need it for later math courses will learn it in a pre-calculus course.

Action Plan and Date for Reassessment

Identify action plan for improvement or maintaining current performance levels including outcomes identified for re-assessment, curriculum revision, LOT proposal, new or revised course activities to reinforce learning outcomes, etc. Append additional pages if necessary. If appending, include notation in box to "See attached".

Outcome 1: Evaluate and analyze functions
Two of the questions that received a lower than desirable percentage of correct responses were the ones on classifying numbers (1.1) and finding domain (1.7). The most common mistake on 1.1 was to include sets to which the number did not belong. More examples in class and more homework problems including a greater variety of numbers will be included in future sections. The concept of finding domain is very important in mathematics, and therefore is stressed continually throughout the semester in both MTH 123 and 135. Despite this, it continues to be an area of difficulty for students. The students that missed 1.7 were not sure how to even approach the problem. It may be beneficial in future semesters to give at least one extra homework assignment devoted solely to finding domain of functions once all the rules for domain are covered.

The other areas of weakness under this outcome were performing operations on functions, composing functions, and finding the inverse of a function, all of which are covered in the same chapter as exponential and logarithmic functions. See the discussion for Outcome 3 below for the plan for improvement.

Outcome 2: Graph linear and nonlinear functions
Since this outcome was met at 76%, no adjustment to instruction is recommended at this time. However, the weaker areas will be given more emphasis and monitoring in future sections, which included finding the distance between two points, finding the equation of a line given two points, finding intercepts, writing the equation of a horizontal line, evaluating piecewise functions, writing an equation of a parabola, and graphing using transformations.

Outcome 3: Solve problems involving exponential and logarithmic functions
The only question under this outcome that the students did *not* have trouble with was 2.23 where they had to evaluate a logarithm using the change-of-base formula. This was one outcome that was not covered in MTH 123 during the Fall 2014 semester due to time constraints, so for many of the students, this was the first time they encountered exponential and logarithmic functions. Consideration was given to eliminating this topic from 123, but this assessment shows that it would be beneficial for the students to see this topic more than once.

Another possible reason for the low performance on this outcome, at least for the adult section, is that the students were given the test on this chapter as a take-home, open-book, open-note test to make up for a snow day, and they were not required to complete a review assignment prior to taking the test as they were for the other chapters. Because of the resources available to the students during the test and the lack of preparation prior to the test, they may not have learned the material as thoroughly as they should have the first time, which then carried over to their final exam. Giving any open-book, open-note tests for this course will be avoided in the future.

Outcome 4: Solve systems of equations and inequalities
Both sections did well with all of the questions under this outcome. No adjustment to instruction is recommended at this time.

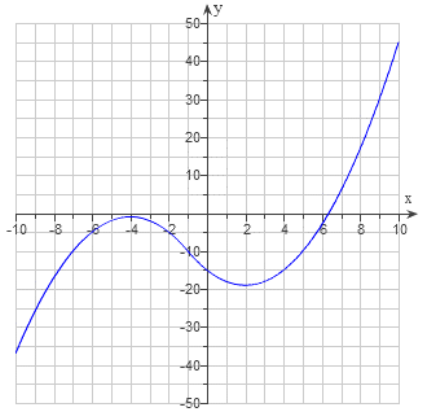
To improve overall performance on the final exam, other alternatives will be considered for the final exam review assignment. As mentioned above, it is currently given as an extra credit assignment, but because it is optional, most students do not put as much time and effort into it as they should. In the future, this will likely be made a *required* assignment with enough weight towards their final grade to motivate the students to do well on it.

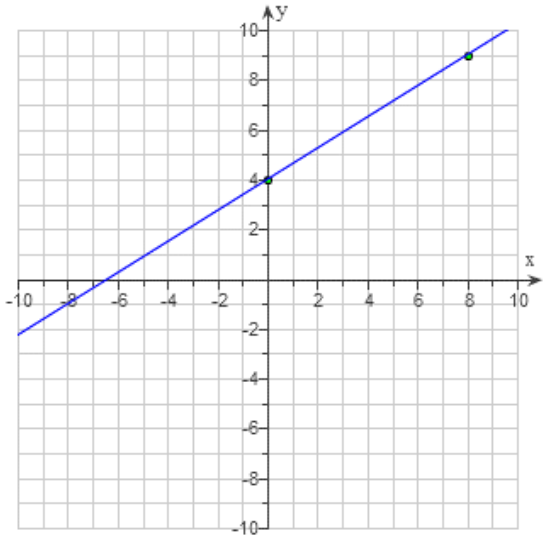
Proposed date for reassessment is Spring 2017.

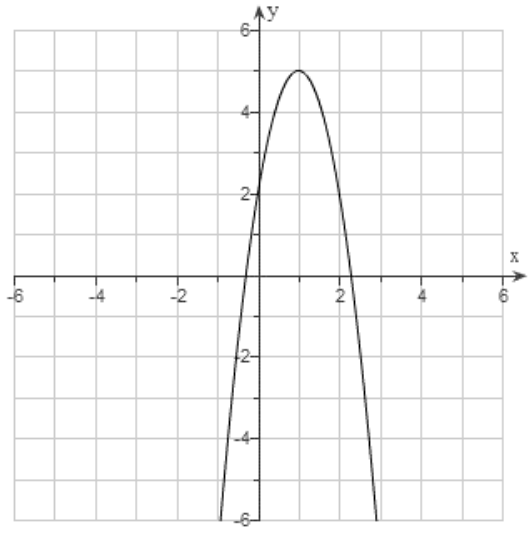
Assessment Committee Recommendation/Approval **(To be posted by Assessment Committee Chair)**
✠ Approved as presented **Date: 09/09/15**

LOT Recommendation/Approval **(To be posted by Assessment Committee Chair)**
✠ Approved as presented **Date: 09/21/15**

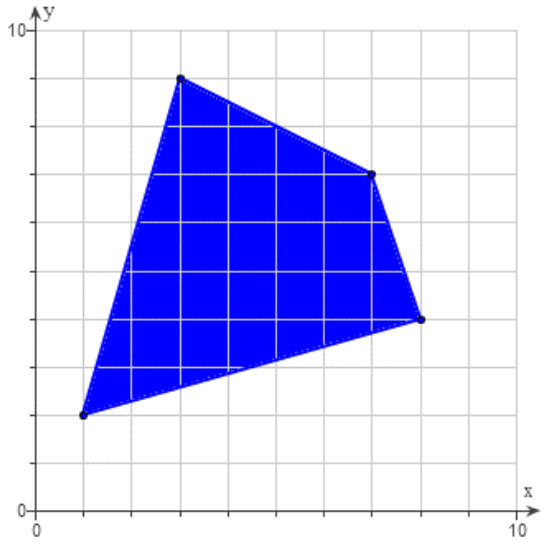
Attachment 1: Performance by Question and by Section

Question	MTH 135-A11 (adult section) Percent of Correct Responses	MTH 135-PAC (high school section) Percent of Correct Responses
1.1. Circle the set or sets to which the number 8.9 belongs. a. natural numbers b. whole numbers c. integers d. rational numbers e. irrational numbers f. real numbers	33%	65%
1.5. Determine whether the relation is a function: {(3,2),(24,-8)(43,2),(3,5),(58,5)}.	100%	85%
1.6. Evaluate $g(x) = \frac{5}{3-5x}$ for $x = 1$.	100%	70%
1.7. Find the domain of $g(x) = \frac{5}{3-5x}$. Write your answer in set-builder notation.	50%	70%
1.8. Use the graph of *f* to determine intervals where *f* is decreasing and where *f* is increasing.  	67%	100%
2.15. If $f(x) = x^2 - 20$ and $g(x) = 2 - x$, find $(fg)(-3)$.	50%	65%
2.16. If $f(x) = \sqrt{5-x}$ and $g(x) = x^2 + 3$, find $(g \circ f)(x)$.	50%	50%

2.17. Find the inverse of the one-to-one function $f(x) = 2x + 1$.	67%	70%
1.2. Find the distance between (-20, -8) and (-23, -17), rounded to the nearest hundredth.	50%	80%
1.3. Find the midpoint of the segment with endpoints (5, -3) and (-1, 0).	100%	95%
1.4. Graph the circle $(x-4)^2 + (y+2)^2 = 4$. Give the center and the radius.	33%	100%
1.9. Find an equation of the line containing the points (-7, -9) and (-1, -8). Write your answer in slope-intercept form.	50%	70%
1.10. Write an equation for the line shown in the graph. Write your answer in slope-intercept form. 	67%	95%
1.11. Find the intercepts of $7x - 5y = 35$ and then use them to graph the equation.	67%	Not on exam
1.12. Write an equation of the line satisfying the following conditions: horizontal, passing through (-3,3).	50%	Not on exam

1.14. Find $f(0)$ if $f(x) = \begin{cases} x - 9, \text{if } x < 6 \\ 4 - x, \text{if } x \geq 6 \end{cases}$.	33%	Not on exam
2.1. Use the graph of f to write its formula as $f(x) = a(x-h)^2 + k$. 	50%	70%
2.5. Graph $f(x) = \frac{1}{2}(x+2)^2$ using transformations. List at least 3 points on the final graph.	50%	80%
2.18. There are initially 2500 bacteria in a sample, and this sample doubles in size every hour. Find values for *C* and *a* so that $f(x) = Ca^x$ gives the number of bacteria after *x* hours.	17%	50%
2.19. Use the formula $A = Pe^{rt}$ to determine the final value of $960 invested at 3% compounded continuously for 15 years.	50%	Not on exam
2.20. Find the domain of $f(x) = \ln(5 - x)$. Write your answer in interval notation.	17%	Not on exam
2.21. Solve $\log_6(6x - 6) = 4$.	33%	85%
2.22. Use the properties of logarithms to write $6 \ln x - \frac{1}{8} \ln y$ as a single logarithm.	17%	50%

2.23. Find $\log_5 70$ rounded to four decimal places.	33%	100%
2.24. Solve $4(1.21)^x + 2 = 13$. Round your answer to the nearest thousandth.	17%	75%
2.25. One method to determine the time since an animal died is to estimate the percentage of carbon-14 remaining in its bones. The percent *P* in decimal form of carbon-14 remaining after *x* years is given by $P(x) = e^{-0.000121x}$. Approximate (to the nearest whole year) the age of a fossil if there is 70% of carbon-14 remaining.	17%	Not on exam
1.17. Solve the system of equations by using the substitution method. $6x - 2y = 4$ $x + y = 0$	83%	85%
1.18. Solve by the elimination method. $7x - y = 34$ $x + 8y = 70$	67%	100%
1.19. Solve the nonlinear system of equations. $x^2 + y = 21$ $4x + y = 0$	50%	85%
1.20. Write the system as an augmented matrix. Then solve the system of equations using row-echelon form and backward substitution. $x + 2y + 4z = 8$ $-x + 3y + 2z = -5$ $x + y - 5z = -16$	50%	95%
1.21. Evaluate $2\begin{bmatrix}-2 & 3\\ -6 & 7\end{bmatrix} - 3\begin{bmatrix}0 & 0\\ -8 & -7\end{bmatrix}$.	50%	95%
1.22. Solve the following system of equations by using $X = A^{-1}B$. $-3x - y + 8z = 22$ $-4y + 6z = 10$ $5x + 6y + 6z = 30$	83%	45%

1.23. Solve the system of equations by using Cramer's rule. $8x + 4y = 1$ $2x + 5y = 13$	83%	85%
1.24. Graph the solution set to the system of inequalities. Give a point in the solution set. $x - 2y \leq 2$ $x + y \leq 0$	50%	Not on exam
1.25. The graph shows a region of feasible solutions. Find the maximum and minimum values of the expression $4x + 8y$. 	67%	Not on exam