Algebra Progress Monitoring in Secondary Mathematics: Using AAIMS Algebra Measures

December 12, 2011

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Pennsylvania Training and Technical Assistance Network

PaTTAN's Mission

The mission of the Pennsylvania Training and Technical Assistance Network (PaTTAN) is to support the efforts and initiatives of the Bureau of Special Education, and to build the capacity of local educational agencies to serve students who receive special education services.

PDE's Commitment to Least Restrictive Environment (LRE)

Our goal for each child is to ensure Individualized Education Program (IEP) teams begin with the general education setting with the use of Supplementary Aids and Services before considering a more restrictive environment.

Training Objectives

- Discuss core tenets of progress monitoring
- Identify features of AAIMS Algebra Progress Monitoring Measures (probes)
- Acquire the skills needed to administer and score progress monitoring Algebra probes

Progress Monitoring

The ongoing process which involves:

- Collecting and analyzing data to determine student progress toward goals and objectives.
- Creating a graphic representation of the data.
- Making instructional decisions based on the review and analysis of student data graphs.

General Outcomes Measures

Simple

Repeated measurement

Growth over time

A simple set of procedures for repeated measurement of student growth toward long-range instructional goals (Deno, 1985).

Big Ideas about General Outcome Measures…

- Indicators of foundational skill success
- Basic skill success for students by age and instructional grade
- Tasks of equal difficulty tied to the general curriculum
- Simple, accurate, and efficient indicators of student achievement
- Designed to assess GROWTH

Algebra Measures

Algebra Assessment and Instruction- Meeting Standards AAIMS

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Project AAIMS Web site

www.ci.hs.iastate.edu/aaims

Technical reports

Project Information

Algebra Resources

Monitoring Critical Skills of Algebra

- Provides formative assessment of student performance
- Allows for assessment of accuracy and fluency
- Provides formative error analysis
- Focuses on objectives (the foundation for success in other aspects of mathematics)
- Includes probes designed to reflect the scope and sequence of the mathematics curriculum

Potential Applications

- Diagnostic tool for new students
- Identifying common errors, forgotten concepts for review/warm-up activities
- Incorporate into IEP goals as a means to monitor algebra progress
- Administer to 8th grade students to assist with decisions about 9th grade algebra course options

Materials Needed

- Student Probes
- Answer Key
- Timer
- Script

Administration Procedures

- Standardized administration
  - Sample scripts provided
  - Initial presentation directions are more elaborate; on-going probes are more brief
  - Verbatim not essential, but consistency is important!
  - Required elements need to be included
- Exact timing

Standard Directions: Required Elements for All Probes

- Prompt to label paper with name and date;
  - *"Please write your name and the date on your paper"*
- Identify the task
  - *"We're going to do a Translations probe"*
- Encourage students to do their best work and as many problems as possible
  - *"Try to do as many problems as you can"*
  - *"Please do your best work"*
- Identify the amount of time to work
  - *"You will have _ minutes to work"*
- Prompt to begin

Available Measures for Monitoring Progress in Algebra

1. (Algebra) Basic Skills
2. Algebra Foundations
3. Translations
4. Content Analysis-Multiple Choice

Basic Skills

- 60 problems
- 5 minutes
- Problems reflect the 'tool skills' of algebra
  - Solving simple equations
  - Applying the distributive property
  - Working with integers
  - Simplifying expressions
  - Applying proportional reasoning

Algebra Basic Skills 1 — Page 1

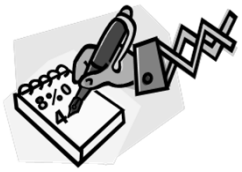
Solve: $9 + a = 15$	$a =$
Evaluate: $12 + (-8) + 3$	
Simplify: $2x + 4 + 3x + 5$	
Solve: $12 - k = 4$	$k =$
Simplify: $4(3 + s) - 7$	
Simplify: $b + b + 2b$	
Solve: $\frac{r}{6} = \frac{12}{18}$	$r =$
Simplify: $7 - 3(f - 2)$	
Evaluate: $-5 + (-4) - 1$	
Solve: $63 + c = 9$	$c =$
Simplify: $2(s - 1) + 4 + 5s$	
Simplify: $8m - 9(m + 2)$	
Solve: 3 ft. = 1 yd. ____ ft. = 9 yds.	
Evaluate: $4 - (-2) + 8$	
Simplify: $2k + 3 - 5(k + 7)$	

Solve: $10 - 6 = g$	$g =$
Simplify: $9 - 4d + 2 + 7d$	
Simplify: $5(b - 3) - b$	
Solve: $q \cdot 5 = 30$	$q =$
Evaluate: $8 - (-6) - 4$	
Simplify: $2 + w(w - 5)$	
Solve: 1 ft. =12 in. 5 ft. = _____ in.	
Simplify: $4 - 7b + 5(b - 1)$	
Simplify: $s + 2s - 4s$	
Solve: $x + 4 = 7$	$x =$
Simplify: $-5(q + 3) + 9$	
Evaluate: $9 + (-3) - 8$	
Solve: $\frac{12}{2} = \frac{48}{m}$	$m =$
Simplify: $y^2 + y - 4y + 3y^2$	
Simplify: $3(c + 2) - 2c$	

OSEP Award# H324C030060

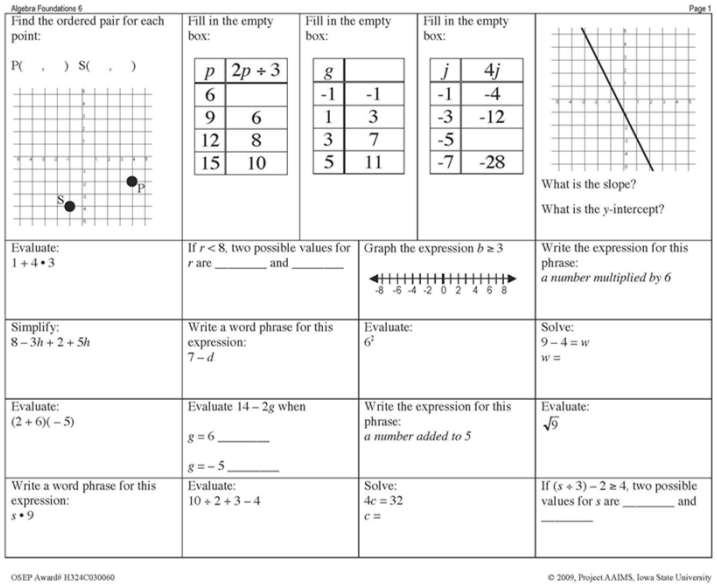
Let's Practice!

Basic Skills Measures



Algebra Foundations

- 42 items worth 50 points
- 5 minutes
- Problems reflect foundational concepts in algebra
  - Writing and evaluating variables and expressions
  - Manipulating expressions (integers, exponents, order of operations)
  - Basic graphing
  - Solving one-step equations and simplifying expressions
  - Identifying and extending patterns and functions



Algebra Foundations 6 — Page 1

Find the ordered pair for each point: P(,) S(,)	Fill in the empty box:	Fill in the empty box:	Fill in the empty box:	
	p | $2p \div 3$ 6 | 9 | 6 12 | 8 15 | 10	g | -1 | -1 1 | 3 3 | 7 5 | 11	j | $4j$ -1 | -4 -3 | -12 -5 | -7 | -28	What is the slope? What is the y-intercept?
Evaluate: $1 + 4 \cdot 3$	If $r < 8$, two possible values for r are _____ and _____	Graph the expression $b \geq 3$		Write the expression for this phrase: *a number multiplied by 6*
Simplify: $8 - 3h + 2 + 5h$	Write a word phrase for this expression: $7 - d$	Evaluate: 6^2		Solve: $9 - 4 = w$ $w =$
Evaluate: $(2 + 6)(-5)$	Evaluate $14 - 2g$ when $g = 6$ _____ $g = -5$ _____	Write the expression for this phrase: *a number added to 5*		Evaluate: $\sqrt{9}$
Write a word phrase for this expression: $s \cdot 9$	Evaluate: $10 \div 2 + 3 - 4$	Solve: $4c = 32$ $c =$		If $(s \div 3) - 2 \geq 4$, two possible values for s are _____ and _____

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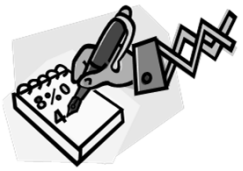
Let's Practice!



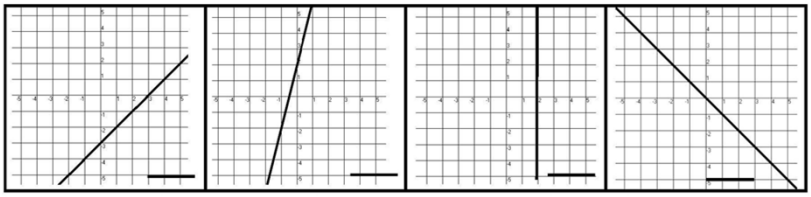
Algebra Foundations Measures

Translations

- 42 problems
- 7 minutes
- Problems reflect conceptual understanding in algebra and the ability to represent relationships in multiple formats
  - Equations
  - Graphs
  - Data tables
  - Story scenarios

Translations 2 Page 1

A	B	C	D
$y = 4x + 2$	$y = x - 3$	$y = -x$	$x = 2$



x	y
4	-4
2	-2
0	0
-2	2
-4	4

x	y
2	4
2	2
2	0
2	-2
2	-4

x	y
2	-2
1	-1
0	0
-1	1
-2	2

x	y
4	18
2	10
0	2
-2	-6
-4	-14

x	y
4	1
2	-1
0	-3
-2	-5
-4	-7

Tim is collecting state quarters for his state. He started his collection with two quarters. He wants to trade in some dollar bills for quarters. Tim wrote this equation to show how many quarters he'll have after the trade.	___
Leah is three years younger than her sister. She wrote this equation to show the relationship between their ages.	___
Every time Joel gets home after curfew, he loses a chance to use the car. Joel wrote this equation to show the relationship between breaking curfew and his chances to use the car.	___
Sam is planning a basketball tournament. He wrote this equation to show the relationship between the number of teams in the championship game and the total number of teams in the tournament.	___
Teresa has taken four quizzes and gotten the same score on each one. She also has two extra credit points. Teresa wrote this equation to show how her total quiz points would be related to the score she gets on each quiz.	___

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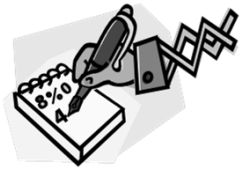
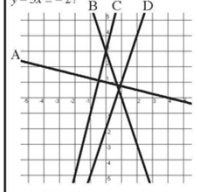
Let's Practice!

Translations Measures



Content Analysis-Multiple Choice

- 16 problems
- 7 minutes
- Multiple choice format
- Problems are sampled from the Algebra I textbook common to all 3 AAIMS districts (McDougal Littell)
- Problems are sampled from the first 8 chapters of the text (earlier versions sampled the entire text)
- Order of the problems is random

Solve: $9c - 4 = 14$ $c =$ a) $\frac{10}{9}$ b) 2 c) 1 d) -2	Find the slope of a line through (2, 6), (9, – 8) a) -2 b) $\frac{3}{5}$ c) $\frac{1}{2}$ d) 2	Evaluate the expression: $(-2)^3$ a) $-\frac{1}{8}$ b) $\frac{1}{6}$ c) -6 d) -8	Write the equation of a line through (– 5, 5) (– 8, –1). Use point-slope form. a) $y - 5 = 2(x - 5)$ b) $y - 5 = \frac{1}{2}(x + 5)$ c) $y - 5 = 2(x + 5)$ d) $y = 2x + 15$
Which line on the graph is $y - 3x = -2$?  a) Line A b) Line B c) Line C d) Line D	Evaluate $(x^3 - 7) \div 4 + y$ when $x = 3$ and $y = 5$ a) 5 b) 11 c) 10 d) 1	Simplify: $10u + 6 + u^2 - 5 - 5u$ a) $u^2 + 15u + 11$ b) $16u^2 + 1$ c) $16u + u^2$ d) $u^2 + 5u + 1$	Simplify: $2(6 - 2a) + 5(6a + 3)$ a) $28a + 15$ b) $38a + 3$ c) $26a + 27$ d) $32a + 9$

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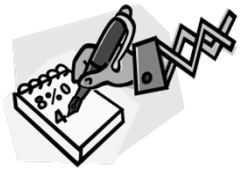
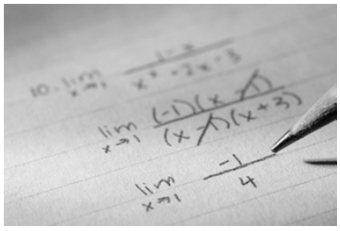
Let's Practice!

Content Analysis Measures

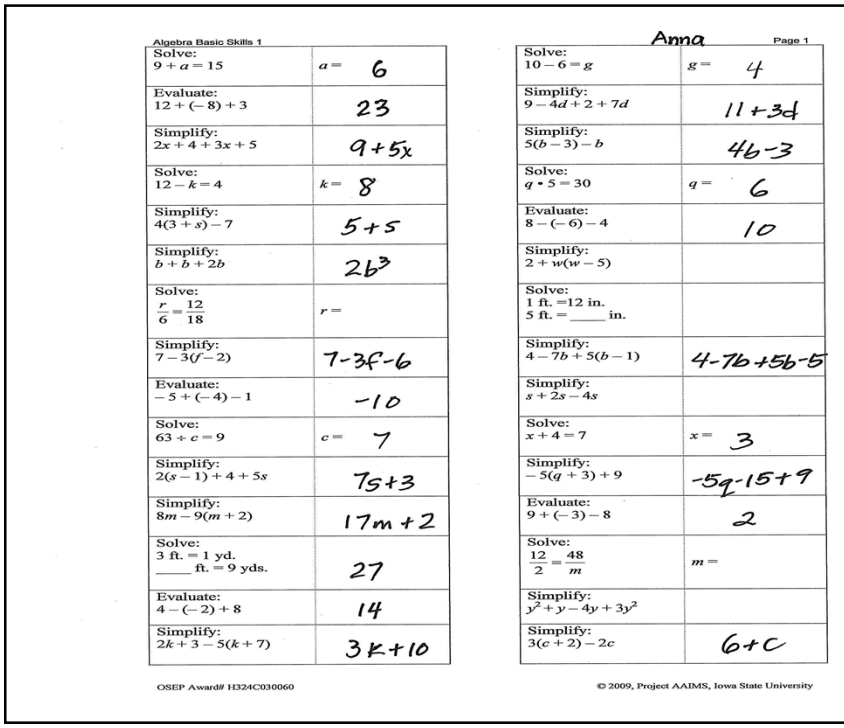


Scoring the Probes



Scoring the Probes: **Basic Skills**

- Problems correct
- Accept mathematically equivalent responses
- Ignore skipped problems; they are neither correct nor incorrect



Algebra Basic Skills 1

Solve: $9 + a = 15$	$a =$ 6
Evaluate: $12 + (-8) + 3$	23
Simplify: $2x + 4 + 3x + 5$	$9+5x$
Solve: $12 - k = 4$	$k =$ 8
Simplify: $4(3 + s) - 7$	$5+5$
Simplify: $b + b + 2b$	$2b^3$
Solve: $\frac{r}{6} = \frac{12}{18}$	$r =$
Simplify: $7 - 3(f - 2)$	$7-3f-6$
Evaluate: $-5 + (-4) - 1$	-10
Solve: $63 \div c = 9$	$c =$ 7
Simplify: $2(s - 1) + 4 + 5s$	$7s+3$
Simplify: $8m - 9(m + 2)$	$17m+2$
Solve: 3 ft. = 1 yd. _____ ft. = 9 yds.	27
Evaluate: $4 - (-2) + 8$	14
Simplify: $2k + 3 - 5(k + 7)$	$3k+10$

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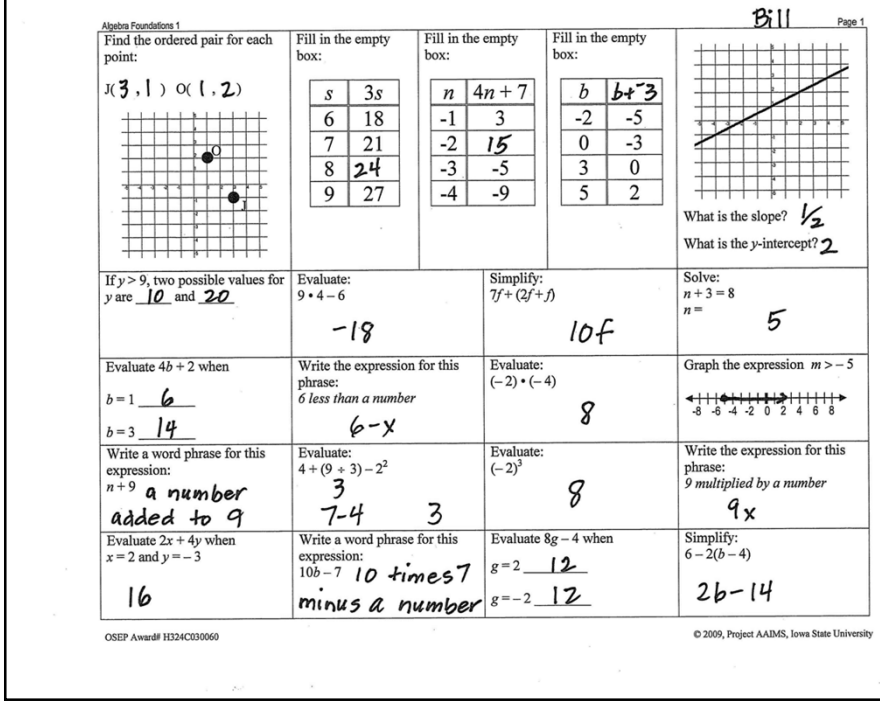
Anna Page 1

Solve: $10 - 6 = g$	$g =$ 4
Simplify: $9 - 4d + 2 + 7d$	$11+3d$
Simplify: $5(b - 3) - b$	$4b-3$
Solve: $q \cdot 5 = 30$	$q =$ 6
Evaluate: $8 - (-6) - 4$	10
Simplify: $2 + w(w - 5)$	
Solve: 1 ft. =12 in. 5 ft. = _____ in.	
Simplify: $4 - 7b + 5(b - 1)$	$4-7b+5b-5$
Simplify: $s + 2s - 4s$	
Solve: $x + 4 = 7$	$x =$ 3
Simplify: $-5(q + 3) + 9$	$-5q-15+9$
Evaluate: $9 + (-3) - 8$	2
Solve: $\frac{12}{2} = \frac{48}{m}$	$m =$
Simplify: $y^2 + y - 4y + 3y^2$	
Simplify: $3(c + 2) - 2c$	$6+c$

Scoring the Probes: **Algebra Foundations**

- Problems correct scoring
- One point per response/blank
- Accept mathematically equivalent responses
- Ignore skipped problems; they are neither correct nor incorrect
- Score coordinate graph problems as 1 point for each ordered PAIR



Algebra Foundations 1 — Bill — Page 1

Find the ordered pair for each point: J(3, 1) O(1, 2)	Fill in the empty box: s | $3s$: 6 | 18; 7 | 21; 8 | 24; 9 | 27	Fill in the empty box: n | $4n+7$: -1 | 3; -2 | 15; -3 | -5; -4 | -9	Fill in the empty box: b | $b+3$: -2 | -5; 0 | -3; 3 | 0; 5 | 2	What is the slope? 1/2 What is the y-intercept? 2
If $y > 9$, two possible values for y are 10 and 20	Evaluate: $9 \cdot 4 - 6$ -18	Simplify: $7f + (2f + f)$ 10f		Solve: $n + 3 = 8$, $n =$ 5
Evaluate $4b + 2$ when $b = 1$ 6; $b = 3$ 14	Write the expression for this phrase: *6 less than a number* 6-x	Evaluate: $(-2) \cdot (-4)$ 8		Graph the expression $m > -5$
Write a word phrase for this expression: $n + 9$ a number added to 9	Evaluate: $4 + (9 + 3) - 2^2$ 3 7-4 3	Evaluate: $(-2)^3$ 8		Write the expression for this phrase: *9 multiplied by a number* 9x
Evaluate $2x + 4y$ when $x = 2$ and $y = -3$ 16	Write a word phrase for this expression: $10b - 7$ 10 times 7 minus a number	Evaluate $8g - 4$ when $g = 2$ 12; $g = -2$ 12		Simplify: $6 - 2(b - 4)$ 2b-14

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Scoring the Probes: **Translations**

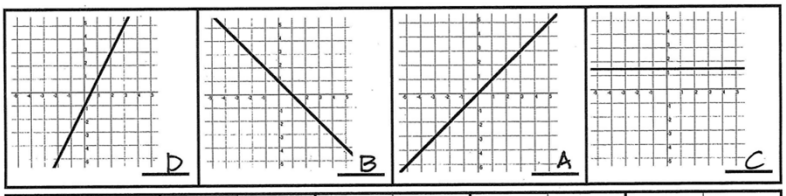
- Translations
  - Count problems correct
  - Count problems incorrect
  - Final score = Correct - Incorrect

Translations 1

Page 1

Deshaun

A	B	C	D
$y = x$	$y = 2x - 1$	$y = 1.5$	$y = -x + 1$



A		B		C		D		E	
x	y	x	y	x	y	x	y	x	y
2	1.5	2	-1	2	3	4	4	4	-3
1	1.5	1	0	1	1	2	2	2	-1
0	1.5	0	1	0	-1	0	0	0	1
-1	1.5	-1	2	-1	-3	-2	-2	-2	3
-2	1.5	-2	3	-2	-5	-4	-4	-4	5
	C		D		B		A		D

Mark needs to find half the width of pieces of pipe he is cutting to make a soccer goal. The width of the pipe is 3 inches. He wrote this equation to show the relationship between the length and the width of the pieces he will cut.	A
Every day that Cindy waters the garden, she earns a dollar. She wrote this equation to show the relationship between the number of days she waters the garden and the number of dollars she will earn.	A
Joe has one dollar in his wallet. He wrote this equation to show the relationship between the number of dollars he borrows from his friends for lunch and the total amount of money he has or owes.	D
The class earns $2 for each magazine subscription sold in the fund-raiser. A $1 fee per student is charged for a processing fee. Cindy wrote this equation to show the relationship between the number of magazines sold and the profit.	
The flood waters are receding at a rate of 1 foot per day. The river is currently at 1 foot above flood stage. Tom wrote this equation to show the relationship between the number of days and the height of the river compared to flood stage.	D

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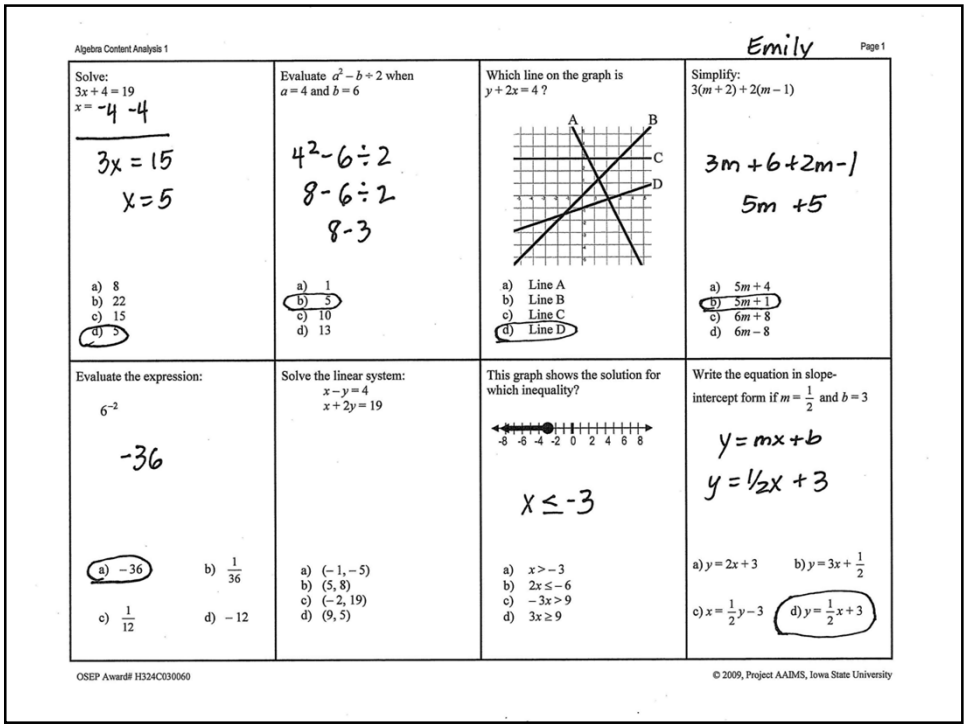
Scoring the Probes: **Content Analysis-Multiple Choice**

- Partial credit scoring procedures
  1. Is the answer correct? (yes=3 pts.)
  2. Is the answer incorrect with no work shown (yes=√) When totaling, count as -1
  3. Compare student's work to scoring rubric
     - Answer has features above the line are worth 1 pt
     - Answer has features below the line are worth 2 pts
     - If work does not align with rubric , no points are earned, score as 0 points



Algebra Content Analysis 1 — Emily — Page 1

Solve: $3x + 4 = 19$

$x =$ -4 -4

$3x = 15$

$x = 5$

a) 8
b) 22
c) 15
d) 5

Evaluate $a^2 - b \div 2$ **when** $a = 4$ **and** $b = 6$

$4^2 - 6 \div 2$

$8 - 6 \div 2$

$8 - 3$

a) 1
b) 5
c) 10
d) 13

Which line on the graph is $y + 2x = 4$ **?**

a) Line A
b) Line B
c) Line C
d) Line D

Simplify: $3(m + 2) + 2(m - 1)$

$3m + 6 + 2m - 1$

$5m + 5$

a) $5m + 4$
b) $5m + 1$
c) $6m + 8$
d) $6m - 8$

Evaluate the expression: 6^{-2}

-36

a) -36
b) $\frac{1}{36}$
c) $\frac{1}{12}$
d) -12

Solve the linear system:

$x - y = 4$

$x + 2y = 19$

a) $(-1, -5)$
b) $(5, 8)$
c) $(-2, 19)$
d) $(9, 5)$

This graph shows the solution for which inequality?

$x \leq -3$

a) $x > -3$
b) $2x \leq -6$
c) $-3x > 9$
d) $3x \geq 9$

Write the equation in slope-intercept form if $m = \frac{1}{2}$ **and** $b = 3$

$y = mx + b$

$y = \frac{1}{2}x + 3$

a) $y = 2x + 3$
b) $y = 3x + \frac{1}{2}$
c) $x = \frac{1}{2}y - 3$
d) $y = \frac{1}{2}x + 3$

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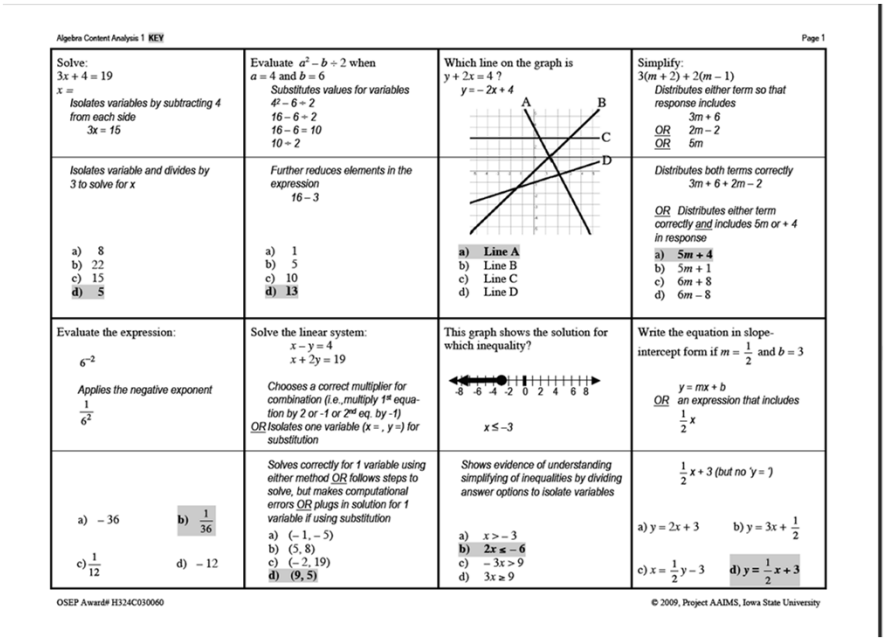

Algebra Content Analysis 1 **KEY** Page 1

Solve: $3x + 4 = 19$ $x =$ *Isolates variables by subtracting 4 from each side* $3x = 15$	Evaluate $a^2 - b \div 2$ when $a = 4$ and $b = 6$ *Substitutes values for variables* $4^2 - 6 \div 2$ $16 - 6 \div 2$ $16 - 6 = 10$ $10 \div 2$	Which line on the graph is $y + 2x = 4$? $y = -2x + 4$	Simplify: $3(m + 2) + 2(m - 1)$ *Distributes either term so that response includes* $3m + 6$ *OR* $2m - 2$ *OR* $5m$
Isolates variable and divides by 3 to solve for x a) 8 b) 22 c) 15 **d) 5**	*Further reduces elements in the expression* $16 - 3$ a) 1 b) 5 c) 10 **d) 13**	**a) Line A** b) Line B c) Line C d) Line D	*Distributes both terms correctly* $3m + 6 + 2m - 2$ *OR Distributes either term correctly and includes 5m or + 4 in response* **a) $5m + 4$** b) $5m + 1$ c) $6m + 8$ d) $6m - 8$
Evaluate the expression: 6^{-2} *Applies the negative exponent* $\frac{1}{6^2}$ a) -36 **b) $\frac{1}{36}$** c) $\frac{1}{12}$ d) -12	Solve the linear system: $x - y = 4$ $x + 2y = 19$ *Chooses a correct multiplier for combination (i.e.,multiply 1st equation by 2 or -1 or 2nd eq. by -1)* *OR Isolates one variable (x = , y =) for substitution* *Solves correctly for 1 variable using either method OR follows steps to solve, but makes computational errors OR plugs in solution for 1 variable if using substitution* a) $(-1, -5)$ b) $(5, 8)$ c) $(-2, 19)$ **d) $(9, 5)$**	This graph shows the solution for which inequality? $x \leq -3$ *Shows evidence of understanding simplifying of inequalities by dividing answer options to isolate variables* a) $x > -3$ **b) $2x \leq -6$** c) $-3x > 9$ d) $3x \geq 9$	Write the equation in slope-intercept form if $m = \frac{1}{2}$ and $b = 3$ $y = mx + b$ *OR an expression that includes* $\frac{1}{2}x$ $\frac{1}{2}x + 3$ *(but no 'y = ')* a) $y = 2x + 3$ b) $y = 3x + \frac{1}{2}$ c) $x = \frac{1}{2}y - 3$ **d) $y = \frac{1}{2}x + 3$**

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Implement Progress Monitoring

- Select type of probe to administer
- Schedule for data collection
  - Depends on your use of the probe and student needs
    - Monthly for year-long classes
    - Twice monthly for block schedule
    - Three times per year for screening
    - Quarterly for progress monitoring

Rates of Average Weekly Progress

Developers of the measures recommend the following rates of average weekly growth, based on the their research :

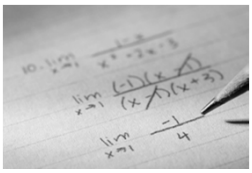
- .4 points/week growth for *Algebra Basic Skills and Algebra Foundations*
- .5 points/week growth for *Algebra Content Analysis*

Data Collection: Using the Algebra Measures

- Choose the type of probe/s to administer (and stay with this type for the entire course)
- Administer and score probes
- Graph data and analyze progress
- Plan instruction

Complete Homework Assignment

1. Participants score **Max Probes**
2. Each participant upon submission of their completed assignment will receive one AAIMS Measures CD with probes and administration instructions.



Options for Submitting Assignment

– Email to algebra@pattanpgh.net

– US Mail to PaTTAN King of Prussia,

Attention Ernie Melcher

- 200 Anderson Rd, King of Prussia, PA 19406

– US Mail to PaTTAN Pittsburgh

Attention Elaine Neugebauer

- 3190 William Pitt Way, Pgh, PA 15238

-Include name and mailing address

Due by January 6, 2012

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