HS Target H

Domain, Target, Standards, DOK, Vertical Alignments, Achievement Levels, Evidence Required, Vocabulary, Response Types, Materials, Attributes, Question Types, and Question Banks (Examples)

Content Domain: Algebra
Target H [m]: A-REI.A Understand solving equations as a process of reasoning and explain the reasoning.
Standards included in Target H: A-REI.A, A-REI.A.2
Vertical Alignment
Achievement Level Descriptors
Evidence Required
Vocabulary
Response Types
Materials
Attributes
Claim 1: Concepts and Procedures (DOK 1, 2) Question Banks
Claim 2 Problem Solving Questions Banks
Claim 3 Communicating Reasoning Question Banks

Content Domain: Algebra

Target H [m]: A-REI.A Understand solving equations as a process of reasoning and explain the reasoning.

Standards included in Target H: A-REI.A, A-REI.A.2

A-REI.A Understand solving equations as a process of reasoning and explain the reasoning.

A-REI.A.2 Solve simple rational and radical equations in one variable and give examples showing how extraneous solutions may arise.

Vertical Alignment

Related Grade 8 standards

8.EE.A Work with radicals and integer exponents.

8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions.
8.EE.A.2 Use square root and cube root symbols to represent solutions to equations of the form x2=p and x3=p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.

8.EE.C Analyze and solve linear equations and pairs of simultaneous linear equations.

8.EE.C.7. Solve linear equations in one variable. a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers). b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

Achievement Level Descriptors

Level 1 Students should be able to explain solution steps for solving one-step linear equations in one variable.

Level 2 Students should be able to look for and make use of structure to solve simple radical equations and simple rational equations in one variable in which the variable term is in the numerator and should understand the solution steps as a process of reasoning. They should be able to understand and explain solution steps for solving linear equations in one variable as a process of reasoning.

Level 3 Students should be able to look for and make use of structure to solve simple radical and rational equations in one variable presented in various forms. They should be able to understand and explain solution steps for solving quadratic, radical, and rational equations in one variable as a process of reasoning.

Level 4 Students should be able to give examples showing how extraneous solutions may arise and why they arise when solving linear, quadratic, radical, and rational equations.

Evidence Required

1. The student solves radical and/or simple rational equations in one variable, including identifying the number and type of real solutions that might exist for the equation (e.g., one, two, infinite, or no real).

2. The student evaluates proposed solutions to radical or simple rational equations, and recognizes where extraneous solution(s) might arise during the solving of the equation.

3. The student solves radical or rational equations in multiple variables.

4. The student identifies equivalent equations to an equation with rational or radical expressions.

Vocabulary

radical, rational, real, solution

Response Types
Multiple Choice, single correct response; Equation/Numeric; Matching Tables

Materials
simple radical and rational equations

Attributes
None

Claim 1: Concepts and Procedures (DOK 1, 2) Question Banks
Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.

Claim 1 A-REI.A.2 DOK Level 1, 2

Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Evidence Required
The student solves radical and/or simple rational equations in one variable, including identifying the number and type of real solutions that might exist for the equation (e.g., one, two, infinite, or no real).

Question Type 1: The stem will present a rational equation in one variable with exactly one rational solution.

1. (DOK 1): Enter the value of x that makes the equation true. $\frac{1}{x}$ =5

Rubric: (1 point) The student enters the correct value of x (e.g., $\frac{1}{5}$).

2. (DOK 2): Enter the value of t that makes the equation true.

$$\frac{1}{t-4} = \frac{3}{t}$$

Rubric: (1 point) The student enters the correct value of t (e.g., 6).

Response Type: Equation/numeric

Question Type 2: The stem will present a radical equation with one or two real solutions.

1. (DOK 1): Enter the value of x that makes the equation true. $\sqrt{x}$=8

Rubric: (1 point) The student enters the correct solution(s) (e.g., 64).

2. (DOK 2): Enter the value(s) of n that make the equation true. $n-1=\sqrt{5n-9}$

Enter one solution in the first response box. If there are two solutions, enter the second solution in the second response box.

Rubric: (1 point) The student enters the correct solution(s) (e.g., 2, 5).

Response Type: Equation/numeric

Claim 1 A-REI.A.2 DOK Level 2
Solve simple rational and radical equations in one variable and give examples showing how extraneous solutions may arise.

Evidence Required:
The student solves radical and/or simple rational equations in one variable, including identifying the number and type of real solutions that might exist for the equation (e.g., one, two, infinite, or no real).

Question Type 1: A table with three equations in one variable, where at least two are rational or radical.

1. Select whether each equation has no real solutions, one real solution, or infinitely many real solutions.

	No Real Solution	**One Real Solution**	**Infinitely Many Real Solutions**
$\sqrt{x}+2=0$			
$\frac{10}{x}=\frac{20}{x+20}$			
$\frac{3}{x}=\frac{2}{x+1}$			

Rubric: (1 point) The student chooses the correct classification for each equation (e.g., No Real Solution, One Real Solution, One Real Solution).

Response Type: Matching Tables

2. Select whether each equation has no real solution, one real solution, or two real solutions.

	No Real Solution	One Real Solution	Two Real Solutions
$\sqrt{t} + 2 = 0$			
$\sqrt{t^2 - 5} = 2$			
$\frac{3}{t} = \frac{2}{t+1}$			

Rubric: (1 point) The student chooses the correct classification for each equation (e.g., No Real Solution, Two Real Solutions, One Real Solution).

3. Select whether each equation has no real solution, one real solution, two real solutions, or infinitely many real solutions.

	No Real Solution	One Real Solution	Two Real Solutions	Infinitely Many Real Solutions
$\sqrt{n} + 2 = 0$				
$\frac{4n}{12} = \frac{3n}{9}$				
$\frac{3}{n} = \frac{2}{n+1}$				
$\sqrt{n^2 - 5} = 2$				

Rubric: (1 point) The student chooses the correct classification for each equation (e.g., No Real Solution, Infinitely Many Real Solutions, One Real Solution, Two Real Solutions).

Response Type: Matching Tables

Claim 1 A-REI.A.2 DOK Level 1

Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Evidence Required:

The student solves radical and/or simple rational equations in one variable, including identifying the number and type of real solutions that might exist for the equation (e.g., one, two, infinite, or no real).

Question Type 1: The stem will present an equation with one or two real solutions.

1. Select Yes or No to indicate whether each value of b is a solution to the given equation.

$$\frac{3}{4} = \frac{2}{b+1}$$

Solution	Yes	No
$b = 3$		
$b = \frac{5}{3}$		
$b = \frac{3}{5}$		

Rubric: (1 point) The student correctly determines whether each value of b is a solution to the equation (e.g., NYN).

Response Type: Matching Tables

Claim 1 A-REI.A.2 DOK Level 2

Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Evidence Required:
The student evaluates proposed solutions to radical or simple rational equations, and recognizes where extraneous solution(s) might arise during the solving of the equation.

Question Type 1: The student is presented with multiple statements about the method of solving a rational or radical equation.

1. A student was finding the solutions to the equation

$1+\sqrt{x-3}=0$ and wrote the four steps shown.

Step 1: $\sqrt{x-3}=-1$
Step 2: $\left(\sqrt{x-3}\right)^2=(-1)^2$
Step 3: $x-3=1$
Step 4: $x=4$

Which statement is an accurate interpretation of the student's work?

A. The student made an error in Step 1.
B. The student made an error in Step 3.
C. The student found the correct solution to the original equation, x = 4.
D. x=4 is a solution to the equation in Step 2, but not to the original equation.

Rubric: (1 point) The student selects the correct statement (e.g., D).

Response Type: Multiple Choice, single correct response

2. A student was finding the solutions to the equation $\sqrt{t^2-5}-2=0$ and wrote the five steps shown.

Step 1: $\sqrt{t^2-5}=2$

Step 2: $\left(\sqrt{t^2-5}\right)^2=2^2$

Step 3: $t^2-5=4$

Step 4: $t^2=9$

Step 5: $t=3,\ t=-3$

Which statement is an accurate interpretation of the student's work?

A. The student made an error in Step 1.
B. The student made an error in Step 3.
C. The student made an error in Step 4.
D. The student found the correct solutions to the equation, t=3 and t=−3.
E. t=3 and t=−3 are solutions to the equation in Step 2, but not to the original equation.

Rubric: (1 point) The student selects the correct statement (e.g., D).

Response Type: Multiple Choice, single correct response

Claim 1 A-REI.A.2 DOK Level 2

These pages were adapted from open source documents available on the Smarter Balanced Website: http://www.smarterbalanced.org/assessments/development/ August 2016

Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Evidence Required:
The student solves radical or rational equations in multiple variables.

Question Type 1: The student is presented with an equation in more than one variable and is given all values for the other variables.

1. For the given equation, enter the value of V when r = 300.

$r=10^{\sqrt{V}}$

2. For the given equation, enter the value of R when I = 18 and V = 9.
$I = \frac{V}{R}$

Rubric: (1 point) The student enters the correct solution(s) (e.g., 900; ½ or 0.5).

Response Type: Equation/Numeric

Question Type 2: The student is presented with an equation in more than one variable that has rational or radical expressions and is asked to solve for one of the variables.
1. Solve the given equation for v. $t=\frac{\sqrt{v}}{3}$ Complete the equation in the response box.

2. Solve the given equation for h.
$B=\frac{V}{h}$

Complete the equation in the response box.
Rubric: (1 point) The student enters the correct equation (e.g., $v=9t^2$; $h=\frac{V}{B}$).

Response Type: Equation/Numeric [Label the response box with the letter the equation is being solved for (e.g., v = ☐)].

Claim 1 A-REI.A.2 DOK Level 2

Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Evidence Required:
The student identifies equivalent equations to an equation with rational or radical expressions.

Question Type 1: The stem will present an equation in one variable with rational or radical expressions and 3 or more equations that are likely to arise from common algebraic

manipulations of the equation.

1. Equivalent equations have exactly the same solution set. Select Yes or No to indicate whether each equation is equivalent to the given equation.

Given: $\sqrt{t+1}+5=0$

Equation	Yes	No
$\sqrt{t+1}=-5$		
$t+1=25$		
$t=24$		

Rubric: (1 point) The student correctly determines whether each equation is equivalent (e.g., YNN).

Response Type: Matching Tables

<u>Claim 2 Problem Solving Questions Banks</u>
Claim Descriptors and Targets

Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem-solving strategies.

<u>Example 1</u>

A restaurant serves a vegetarian and a chicken lunch special each day. Each vegetarian special is the same price.

Each chicken special is the same price. However, the price of the vegetarian special is different from the price of the chicken special.

- On Thursday, the restaurant collected $467 selling 21 vegetarian specials and 40 chicken specials.
- On Friday, the restaurant collected $484 selling 28 vegetarian specials and 36 chicken specials.

Enter the cost, in dollars, of the vegetarian lunch special.
Rubric: (1 point) The student correctly determines the cost of the vegetarian special (7).

Response Type: Equation/Numeric

<u>Example 2</u>

A type of pasta is made of two ingredients, quinoa and corn. The pasta company is not disclosing the amount of each ingredient in the pasta, but we know that the quinoa in the pasta contains 16.2% protein, and the corn in the pasta contains 3.5% protein. Overall, each 57 gram serving of pasta contains a total of 4 grams of protein.

How many grams of quinoa and how many grams of corn is in one serving of the pasta?

Enter the number of grams of quinoa in the first response box, Enter the number of grams of corn in the second response box. Round each amount to the nearest gram.

Quinoa:

Corn:

Rubric: (2 points) The student enters the correct number of grams for quinoa and corn into the response boxes (16 and 41).(1 point) Either the student reverses the answers (confused between quinoa and corn) or only answers one correctly.

Response Type: Equation/Numeric (2 response boxes)

Claim 3 Communicating Reasoning Question Banks

Claim Descriptors and Targets

Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.

Example 1

Beth is solving this equation: $\frac{1}{x}+3=\frac{3}{x}$.

She says "I can multiply both sides by x and get the linear equation 1 + 3x = 3, whose solution is x = $\frac{2}{3}$."

Which of the following statements makes this a correct argument, or shows that it is incorrect? Select all that apply.

A. You can assume $x \neq 0$ because both sides are undefined if x = 0.
B. After multiplying both sides by x you need to subtract 1 from both sides.
C. You cannot multiply both sides by x because you do not know what x is.
D. The equation is not linear, so you cannot use the methods normally used for solving linear equations.

Rubric: (1 point) The students selects A, or A and B.

These pages were adapted from open source documents available on the Smarter Balanced Website: http://www.smarterbalanced.org/assessments/development/ August 2016

Response type: Multiple Choice, multiple correct response

Example 2

Determine whether each statement is

- true for all values of x,
- true for some values of x, or
- not true for any value of x

Statement	True for all	True for some	Not true for any
If $x^2 = 9$, then $\sqrt{9} = x$			
If $x^3 = y$, then $\sqrt[3]{y} = x$			
If $(-x)^4 = y$, then $\sqrt[4]{y} = (-x)$			

Rubric: (1 point) The student correctly selects True for all, True for some, or Not true for any for each statement correctly (see below).

Statement	True for all	True for some	Not true for any
If $x^2 = 9$, then $\sqrt{9} = x$			
If $x^3 = y$, then $\sqrt[3]{y} = x$			
If $(-x)^4 = y$, then $\sqrt[4]{y} = (-x)$			

Response Type: Matching Tables

Example 3

A student solves a quadratic equation this way:

Equation: $x2-3x-4=0$
Step 1: $x^2-3x=4$
Step 2: $x(x-3)=4$
Step 3: $x=2$ or $x-3=2$
Step 4: $x=2$ or $x=5$
The solution is incorrect. Identify the step that does not follow logically from the previous step.
A. Step 1
B. Step 2
C. Step 3
D. Step 4

Rubric: (1 point) Student selects the incorrect step (C).

These pages were adapted from open source documents available on the Smarter Balanced Website: http://www.smarterbalanced.org/assessments/development/ August 2016

Response Type: Multiple Choice, single correct response