

TIS Mathematics Item			
Task Model 1	Prompt Features: Enter the solution for a rational or radical equation.		
Response Type:	Stimulus Guidelines:		
Equation/numeric	The student is presented with an equation that contains a		
	rational or radical expression.		
DOK Levels 1, 2	 The equation must have at least one solution. 		
	 Solutions must be rational numbers. Standard procedures for solving the equation 		
A-REI.A.2	should not produce extraneous roots.		
Solve simple rational	Item difficulty can be adjusted via these example		
and radical equations in	methods, but are not limited to these methods:		
one variable, and give	• The variable is present on only one side of the		
examples showing how	equation.		
extraneous solutions	 There are multiple rational expressions on both 		
may arise.	sides of the equation.		
	 There are multiple rational expressions with differing dependence 		
Evidence Required:	differing denominators.		
1. The student solves	• There are radicals of the form \sqrt{ax} where a is a		
radical and/or simple	constant and x is a variable.		
rational equations in one	• There are radicals of the form $\sqrt{ax+b}$ where a		
variable, including identifying the number	and b are constants and x is a variable.		
and type of real			
solutions that might	TM1a		
exist for the equation	Stimulus: The stem will present a rational equation in one		
(e.g., one, two, infinite,	variable with exactly one rational solution.		
or no real).	Example Step 1 (DOK 1). Enter the value of y that makes the		
To clas None	Example Stem 1 (DOK 1): Enter the value of <i>x</i> that makes the equation true.		
Tools: None			
	$\frac{1}{-}=5$		
	$\frac{-}{x} = 5$		
	Rubric: (1 point) The student enters the correct value of x		
	$(e.g., \frac{1}{5}).$		
	Example Stem 2 (DOK 2): Enter the value of <i>t</i> that makes the		
	equation true.		
	1 3		
	$\frac{1}{t-4} = \frac{3}{t}$		
	Rubric: (1 point) The student enters the correct value of t		
	(e.g., 6).		
	Response Type: Equation/numeric		



Task Model 1	TM1b Stimulus: The stem will present a radical equation with one or two real solutions.
Response Type:	
Equation/numeric	Example Stem 1 (DOK 1): Enter the value of <i>x</i> that makes the equation true.
DOK Levels 1, 2	$\sqrt{x} = 8$
A-REI.A.2	Rubric:
Solve simple rational and radical equations in one variable, and give examples showing how	(1 point) The student enters the correct solution(s) (e.g., 64).
extraneous solutions may arise.	Example Stem 2 (DOK 2): Enter the value(s) of <i>n</i> that make the equation true.
Evidence Required:	$n-1 = \sqrt{5n-9}$
1. The student solves radical and/or simple rational equations in one	Enter one solution in the first response box. If there are two solutions, enter the second solution in the second response box.
variable, including identifying the number and type of real	Rubric: (1 point) The student enters the correct solution(s) (e.g., 2, 5).
solutions that might exist for the equation (e.g., one, two, infinite, or no real).	Response Type: Equation/numeric
Tools: None	



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HS Mathematics Item	Specification (LIH		Assessment Consortiu
Task Model 1	Prompt Feature rational or radica		mber of real solu	tions for a
Response Type:		·		
	Stimulus Guide			
Matching Tables		or radical express		n that contains a
			exist, must be ra	tional numbers
DOK Level 2			usted via these e	
			ited to these me	
A-REI.A.2			esent on only one	
Solve simple rational		uation.	,	
and radical equations in	o Th	ere are multiple	rational express	sions on both
one variable and give		les of the equation		
examples showing how			rational express	sions with
extraneous solutions may arise.		ffering denomination	of the form \sqrt{ax}	- whore a is a
		Instant and x is a		
Evidence Required:	0 Tł	ere are radicals	of the form \sqrt{ax}	r + b where a
1. The student solves			ts and x is a vari	
radical and/or simple	u u			
rational equations in one	TM1c			
variable, including			uations in one va	ariable, where at
identifying the number and type of real	least two are rat	ional or radical.		
solutions that might				
exist for the equation	Example Stem	1: Select wheth	er each equatior	has no real
(e.g., one, two, infinite,	solutions, one re			
or no real).				
		No Real	One Real	Infinitely
Tools: None		Solution	Solution	Many Real
				Solutions
	$\sqrt{x} + 2 = 0$			
	$\sqrt{x} + 2 = 0$			
	10 20			
	x x + 20			
	$\frac{3}{x} = \frac{2}{x+1}$			
	$x^{-}x + 1$			
	— • • • • • •	· · · · · ·		
				ct classification
	for each equatio			ct classification eal Solution, One
	for each equatio			
	for each equatio Real Solution).	n (e.g., No Real	Solution, One Ro	
	for each equatio	n (e.g., No Real	Solution, One Ro	



Task Model 1

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

Response Type: Matching Tables

DOK Level 2

A-REI.A.2

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

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).

Tools: None

	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).

Example Stem 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



TIS Machematics Item			
Task Model 1	Prompt Features: Select solutions to a given rational or radical equation.		
Response Type:	Stimulus Guidelines:		
Matching Tables	 The student is presented with an equation that contains a matienal energy disclosure action 		
	rational or radical expression.		
DOK Level 1	 The equation has one or more rational solutions. Item difficulty can be adjusted via these example methods, but are not limited to these methods: 		
A-REI.A.2	\circ The variable is present on only one side of the		
Solve simple rational	equation.		
and radical equations in	 There are multiple rational expressions on both 		
one variable, and give	sides of the equation.		
examples showing how	• There are multiple rational expressions with		
extraneous solutions	differing denominators.		
may arise.	• There are radicals of the form \sqrt{ax} where <i>a</i> is a constant and <i>x</i> is a variable.		
Evidence Required:	• There are radicals of the form $\sqrt{ax+b}$ where a		
1. The student solves			
radical and/or simple	and b are constants and x is a variable.		
rational equations in one	TM1d		
variable, including	Stimulus: The stem will present an equation with one or two real solutions.		
identifying the number			
and type of real			
solutions that might	Example Stem: Select Yes or No to indicate whether each value		
exist for the equation	of b is a solution to the given equation.		
(e.g., one, two, infinite,			
or no real).	3 2		
	$\frac{3}{4} = \frac{2}{b+1}$		
To she News			
Tools: None	Solution Yes No		
	<i>b</i> = 3		
	$b = \frac{5}{2}$		
	$b = \frac{1}{3}$		
	3		
	$b = \frac{1}{5}$		
	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		



Task Model 2	Prompt Features: Identify the statement that correctly applies to the given method of solving an equation.
Response Type: Multiple Choice, single correct response DOK Level 2 A-REI.A.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	 Stimulus Guidelines: The student is presented with a student's step-by-step method of solving a rational or radical equation. Item difficulty can be adjusted via these example methods, but are not limited to these methods: The variable is present on only one side of the equation. There are multiple rational expressions on both sides of the equation. There are multiple rational expressions with differing denominators. There are radicals of the form √ax where a is a constant and x is a variable. There are radicals of the form √ax+b where a and b are constants and x is a variable.
Evidence Required: 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.	TM2 Stimulus: The student is presented with multiple statements about the method of solving a rational or radical equation. Example Stem 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: $(\sqrt{x-3})^2 = (-1)^2$ Step 3: $x-3 = 1$ Step 4: $x = 4$
Tools: None	Which statement is an accurate interpretation of the student's work?
Version 3 Update: Revised wording of example stems 1 and 2 and the corresponding options.	 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



Task Model 2	Example Stem 2: A student was finding the solutions to the equation $\sqrt{t^2-5}-2=0$ and wrote the five steps shown.
Response Type: Multiple Choice, single correct	Step 1: $\sqrt{t^2 - 5} = 2$ Step 2: $(\sqrt{t^2 - 5})^2 = 2^2$
response	Step 3: $t^2 - 5 = 4$
DOK Level 2	Step 4: $t^2 = 9$
	Step 5: $t = 3, t = -3$
A-REI.A.2	
Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	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.
Evidence Required: 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.	Rubric: (1 point) The student selects the correct statement (e.g., D). Response Type: Multiple Choice, single correct response
Tools: None	
Version 3 Update: Revised wording of example stems 1 and 2 and the corresponding options.	



Task Model 3 Response Type: Equation/Numeric	Prompt Features: The student is given an equation with more than one variable that reduces to a rational or radical equation in one variable when values for the other variables are given. The student is asked to solve the equation for given values of the other variables.
DOK Level 2 A-REI.A.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. Evidence Required: 3. The student solves radical or rational equations in multiple variables.	 Stimulus Guidelines: The equation has multiple variables. The student is given values for all but one of the variables. The equation reduces to a simple rational or radical equation. The solution must be rational. If the student reports the solution as a decimal, it should be rounded to the nearest tenth. Equations should use a variety of letters for the variables. TM3a Stimulus: The student is presented with an equation in more than one variable and is given all values for the other variables. Example Stem 1: For the given equation, enter the value of V when r = 300. r = 10√V
Tools: None Version 3 Update: Added new "Evidence required" statement 3 and new task models TM3a and TM3b.	Example Stem 2: For the given equation, enter the value of <i>R</i> when $I = 18$ and $V = 9$. $I = \frac{V}{R}$ Rubric: (1 point) The student enters the correct solution(s) (e.g., 900; $\frac{1}{2}$ or 0.5). Response Type: Equation/Numeric
	Response Type. Equation/Numeric



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Task Model 3	Prompt Features: The student is given an equation with more than one variable that is linear in one of the variables. The student is asked to solve for that variable in terms of the other
Response Type:	variables.
Equation/Numeric	
	Stimulus Guidelines:
DOK Level 2	 The equation has multiple variables and is linear in one or more of those variables.
A-REI.A.2	 Item difficulty can be varied by adjusting the number of steps involved in solving equations, as well as the use of
Solve simple rational	parentheses.
and radical equations in one variable, and give examples showing how extraneous solutions may arise.	TM3b Stimulus: 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.
	Example Stem 1: Solve the given equation for <i>v</i> .
Evidence Required: 3. The student solves	_
radical or rational	$t = \frac{\sqrt{v}}{3}$
equations in multiple	3
variables.	Complete the equation in the response box.
Tools: None	Example Stem 2: Solve the given equation for <i>h</i> .
	V
Version 3 Update:	$B = \frac{V}{h}$
Added new "Evidence required" statement 3	
and new task models TM3a and TM3b.	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., $v = \Box$)].



Task Model 4	Prompt Features: Given an equation in one variable with rational or radical expressions, identify equivalent equations.		
Response Type: Matching Tables DOK Level 2	 Stimulus Guidelines: The student is presented with a rational or radical equation in one variable and another set of equations. The student must identify which of the equations in the set are equivalent to the first. 		
A-REI.A.2	ТМ4		
Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions	Stimulus: 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.		
may arise.	Example Stem: Equivalent equations have exactly the same solution set. Select Yes or No to indicate whether each equation is equivalent to the given equation.		
Evidence Required: 4. The student identifies equivalent equations to	Given: $\sqrt{t+1} + 5 = 0$		
an equation with rational or radical	Equation Yes No		
expressions.	$\sqrt{t+1} = -5$		
	t + 1 = 25		
Tools: None	<i>t</i> = 24		
Version 3 Update: Added new "Evidence required" statement 4 and new task model TM4.	Rubric: (1 point) The student correctly determines whether each equation is equivalent (e.g., YNN). Response Type: Matching Tables		