

Task Model 1	Prompt Features: Given an expression in radical form, identify an equivalent expression in exponent form.				
Response Type: Multiple Choice, single correct response	 Stimulus Guidelines: For radicals (e.g., ^q√p^r) p may be either a number (except 0 or 1), or a variable. Item difficulty can be adjusted via these example methods, but are not limited to these methods: 				
DOK Level 1	• Expressions can be given in $\sqrt[q]{p^r}$ form where p is a number (except 0 or 1).				
 N-RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents. Evidence Required: The student rewrites expressions in radical form into an equivalent expression with rational exponents. Tools: None 	 number (except 0 or 1). Expressions can be given in ^q√p^r form where p is a variable. Expressions can be given in ^q√p^s/p^r form where p is a number (except 0 or 1), or a variable. TM1a Stimulus: The student will be presented with an expression of the form ^q√p^r. Example Stem: Select an expression that is equivalent to ^q√3⁶. A. 3^{2/3}/2 B. 3^{3/2}/2 C. 3³ D. 3¹⁵ Rubric: (1 point) The student correctly selects the equivalent rational form (e.g., A). 				
	the form $\sqrt[q]{p_r^s}$.				
	Example Stem: Select an expression that is equivalent to $\sqrt[4]{x^{\frac{2}{3}}}$.				
	A. $x^{\frac{1}{4}}$ B. $x^{\frac{9}{4}}$ C. $x^{\frac{1}{6}}$ D. $x^{\frac{8}{3}}$				
	Rubric: (1 point) The student correctly selects the equivalent rational form (e.g., C).				
	Response Type: Multiple Choice, single correct response				



Task Model 2	Prompt Features: Given an expression in rational form, identify an equivalent expression in radical form.			
Response Type: Multiple Choice, single correct response DOK Level 1 N-RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.	 Stimulus Guidelines: For rational exponents (e.g., p^r/_q) p may be either: a number (except 0 or 1), or a multi-term expression, or a variable with an integer coefficient. Item difficulty can be adjusted via these example methods, but are not limited to these methods: Expressions can be given as p^r/_q where p is a number (except 0 or 1). Expressions can be given as p^r/_q where p is a variable that may or may not have an integer coefficient. 			
Evidence Required: 2. The student will be able to rewrite	Stimulus: The student will be presented with an expression of the form $p^{\frac{r}{q}}$.			
expressions with rational exponents into an equivalent expression in radical form.	A. $\sqrt[9]{3^6}$ B. $\sqrt[6]{3^9}$ C. $\sqrt{3^3}$ D. $\sqrt[3]{3}$			
Tools: None	Rubric: (1 point) The student correctly selects the equivalent radical form (e.g. A).			
	Response Type: Multiple Choice, single correct response			



Task Model 2	Prompt Features: Given an expression in rational form, identify an equivalent expression in radical form.					
Response Type:	Stimulus Guidelines:					
Matching Tables	• For rational exponents (e.g., $n_{\overline{q}}^{\underline{r}}$) p may be either:					
	 a number (except 0 or 1), or 					
DOK Level 1	 a multi-term expression, or 					
	 a variable with an integer coefficient. Item difficulty can be adjusted via these avamula methods. 					
N-RN.2	but are not limited to these methods:					
Rewrite expressions	• Expressions can be given as $p^{\frac{r}{q}}$ where p is a number					
rational exponents using	(except 0 or 1).					
the properties of	\circ Expressions can be given as $p^{rac{r}{q}}$ where p is a variable					
exponents.	that may or may not have an integer coefficient.					
	TM2b					
Evidence Required:	Stimulus: The student will be presented with an expression of					
2. The student will be able to rewrite	the form $p^{\frac{r}{q}}$.					
expressions with						
rational exponents into	Example Stem 1: Determine whether each expression is					
an equivalent	equivalent to $x^{\overline{3}}$. Select Yes or No for each expression.					
form.	Ves No					
	\sqrt{x}					
Tools: None	$\sqrt[3]{x^5}$					
	$5\sqrt{x^3}$					
	$\sqrt{\frac{5}{\pi^2}}$					
	Example Stem 2: Determine whether each expression is					
	equivalent to $(2x^3)^{\frac{5}{5}}$. Select Yes or No for each expression.					
	Yes No					
	$\frac{5\sqrt{4\chi^6}}{\sqrt{4\chi^6}}$					
	$x\sqrt[5]{4}$					
	$\frac{5}{\sqrt{2x^6}}$					
	$x\sqrt[5]{4x}$					
	$\sqrt[5]{4x^3}$					
	Rubric: (1 point) The student correct identifies the equivalent expression(s) (e.g. NYNN; YNNYN)					
	Response Type: Matching Tables					



Task Model 3	Prompt Features: Given an expression in radical form, identify an equivalent expression in exponent form.			
Task Model 3 Response Type: Multiple Choice, single correct response DOK Level 1 N-RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents. S. The student uses the properties of exponents to write equivalent expressions involving radicals and rational exponents. Tools: None	Prompt Features: Given an expression in radical form, identify an equivalent expression in exponent form. Stimulus Guidelines: • For radicals (e.g., $\sqrt[np]{r}$, $\sqrt[np]{r}$			
	Response Type: Multiple Choice, single correct response			
	Response Type: Multiple Choice, single correct response			



Task Model 3	Prompt Features: Given an expression in rational form, identify an equivalent expression in radical form.			
Response Type: Multiple Choice, single correct response	Stimulus Guidelines for TM3b and TM3c: same as for TM3a TM3b Stimulus: The student will be presented with an expression in			
DOK Level 1	the form $p^{\frac{r}{q}} \cdot p^{\frac{s}{t}}$.			
N-RN.2 Rewrite expressions involving radicals and	to $16^{\frac{1}{4}} \cdot 16^{\frac{2}{3}}$. A. $\sqrt[12]{16^{11}}$ B. $\sqrt[7]{16^3}$			
the properties of exponents.	D. $\sqrt[6]{16^2}$ D. $\sqrt[6]{16^4}$			
Evidence Required: 3. The student uses the properties of exponents to write equivalent expressions involving radicals and rational exponents.	Example Stem 2: Select an expression that is equivalent to $\left(\frac{1}{3}\right)x^{\frac{1}{4}} \cdot \left(\frac{1}{3}\right)x^{\frac{2}{3}}$. A. ${}^{\frac{12}{3}}\sqrt{3x^2}$ B. ${}^{6}\sqrt{\left(\frac{1}{3}\right)x^4}$ C. $\frac{1}{9}{}^{\frac{12}{3}}\sqrt{x^{11}}$			
Tools: None	Rubric: (1 point) The student correctly selects the equivalent radical form (e.g., A; C).			
	TM3c Stimulus: The student will be presented with an expression of the form $p^{\frac{r}{q}}(\sqrt[t]{p^s} + p^m)$.			
	Example Stem: Select an expression that is equivalent to $8^{\frac{1}{3}}(\sqrt[3]{8^2} + 8^2)$.			
	A. $\sqrt{8^9} + 8^{\frac{3}{7}}$ B. $\sqrt[3]{8^3} + 8^{\frac{7}{3}}$ C. $\sqrt[7]{8^3} + 8^{\frac{3}{2}}$ D. $\sqrt[9]{8^2} + 8^{\frac{7}{3}}$			
	Rubric: (1 point) The student correctly selects the equivalent radical form (e.g., C).			
	Response Type: Multiple Choice, single correct response			



Task Model 3	Prompt Features: Solve for a variable that will create equivalent expressions with radicals and rational exponents.			
Response Type: Equation/Numeric DOK Level 2 N-RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents. Evidence Required: 3. The student uses the properties of exponents to write equivalent expressions involving radicals and rational exponents. Tools: None	 Stimulus Guidelines: For radicals (e.g., ^q√p^r, ^q√p^r, ^t√p^s), for rational exponents (e.g., p^{^T/q}, p^{^T/n}, p^m/n) and for complex expressions (e.g., p^{^T/q}(^t√p^s + p^m); ^q√p^T/p^T; p^T/p^T, p^T/p^T) p may be either: a number (except 0 or 1), or a nulti-term expression, or a variable with an integer coefficient, provided that there are no other variables in the expression. For rational exponents, n, q, or t may be a variable provided that the corresponding m, r, or s is the same variable. Item difficulty can be adjusted via these example methods, but are not limited to these methods: p can be a number (except 0 or 1), or equation is in ^q√p^T/m = p^S/t form with one variable. p can be a number (except 0 or 1), or equation is in ^q√p^T/m = p^S/t form with one variable. c p can be a number (except 0 or 1) or a variable with or without an integer coefficient, or equation is in ^q√p^T · ^t√p^S = p^m/n, or p^T/q · p^S/t = ⁿ√p^m form with one variable. c p can be a number (except 0 or 1) or a variable with or without an integer coefficient, or equation is in ^q√p^T · ^t√p^S = p^m/n, or p^T/q · p^S/t = ⁿ√p^m form with one variable. Equations can be in either ^{p^T/q}/p^T = ⁿ√p^m form with one variable. Answer choices can be in radical form. 			
	TM3d Stimulus: The student will be presented with an equation of the form $\sqrt[q]{p^{\frac{r}{m}}} = p^{\frac{s}{t}}$. • <i>m</i> , <i>q</i> , <i>r</i> , <i>s</i> , <i>or t</i> may be replaced with a variable. Example Stem: Enter the value of <i>x</i> such that $\sqrt[4]{64^{\frac{1}{3}}} = 64^{\frac{1}{x}}$ is true. Rubric: (1 point) The student enters the correct value of the variable (e.g., 12). Response Type: Equation/Numeric			



Task Model 3	Prompt Features: Solve for a variable that will create equivalent expressions with radicals and rational exponents.			
Response Type: Equation/Numeric	Stimulus Guidelines for TM3e-h: same as for TM3d			
DOK Level 2	TM3e Stimulus: The student will be presented with an equation in the form $\sqrt[q]{p^r} \cdot \sqrt[t]{p^s} = p^{\frac{m}{n}}$.			
N-RN.2	• <i>m</i> , <i>n</i> , <i>q</i> , <i>r</i> , <i>s</i> , <i>or t</i> may be replaced with a variable.			
Rewrite expressions involving radicals and rational exponents using the properties of	Example Stem: Enter the value of x such that $\sqrt[3]{27^2} \cdot \sqrt[3]{27^5} = 27^{\frac{x}{3}}$ is true.			
exponents.	(1 point) The student enters the correct value of the variable (e.g., 7).			
Evidence Required: 3. The student uses the properties of exponents	Response Type: Equation/Numeric			
expressions involving radicals and rational exponents.	TM3f Stimulus: The student will be presented with an equation in the form $p^{\frac{r}{q}} \cdot p^{\frac{s}{t}} = \sqrt[n]{p^m}$.			
Tools: None	• <i>m</i> , <i>n</i> , <i>q</i> , <i>r</i> , <i>s</i> , <i>or t</i> may be replaced with a variable.			
	Example Stem: Enter the value of x such that $3^{\frac{4}{5}} \cdot 3^{\frac{3}{x}} = \sqrt[5]{3^7}$ is true.			
	Rubric: (1 point) The student enters the correct value of the variable (e.g., 5).			
	TM3g Stimulus: The student will be presented with an equation of the $\frac{r}{2}$			
	form $\frac{p^q}{p^{\overline{t}}} = \sqrt[n]{p^m}$. • m, n, q, r, s or t may be replaced with a variable.			
	Example Stem: Enter the value of x such that $\frac{16^{\frac{2}{4}}}{16^{\frac{1}{x}}} = \sqrt[3]{16^3}$ is			
	true.			
	Rubric: (1 point) The student enters the correct value of the variable. (e.g., 4).			
	Response Type: Equation/Numeric			



Task Model 3	Prompt Features: Solve for a variable that will create equivalent expressions with radicals and rational exponents.
Response Type:	
Equation/Numeric	TM3h Stimulus: The student will be presented with an equation of the
DOK Level 2	form $\frac{p^{\frac{r}{q}}}{t/p^{s}} = p^{\frac{m}{n}}$.
N-RN.2	• m , n , q , r , s , or t may be replaced with a variable.
Rewrite expressions involving radicals and rational exponents using the properties of	Example Stem: Enter the value of x such that $\frac{4^{\frac{3}{2}}}{\sqrt[3]{4^4}} = 4^{\frac{x}{2}}$ is true.
	(1 point) The student enters the correct value of the variable $(e, q, -2)$
Evidence Required: 3. The student uses the	
properties of exponents to write equivalent expressions involving radicals and rational exponents.	Response Type: Equation/Numeric
Tools: None	



Task Model 3	Prompt Features: Solve for a variable that will create equivalent expressions with radicals and rational exponents.			
Response Type: Multiple Choice, single correct response DOK Level 2 N-RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents	Stimulus Guidelines: same as for TM3d TM3i Stimulus: The student will be presented with an expression of the form $p^{\frac{r}{q}} \cdot \sqrt[t]{p^s}$. Example Stem 1: Select an expression that is equivalent to $5^{\frac{3}{8}} \cdot \sqrt[t]{5^2}$. A. $5^{\frac{6}{32}}$ B. $5^{\frac{5}{12}}$ C. $5^{\frac{12}{16}}$			
Evidence Required: 3. The student uses the properties of exponents to write equivalent expressions involving radicals and rational exponents. Tools: None	D. $5^{\frac{7}{8}}$ Example Stem 2: Select an expression that is equivalent to $y^{\frac{3}{8}} \cdot \sqrt[4]{y^2}$. A. $y^{\frac{6}{32}}$ B. $y^{\frac{5}{12}}$ C. $y^{\frac{12}{16}}$ D. $y^{\frac{7}{8}}$			
	Example Stem 3: Select an expression that is equivalent to $5^{\frac{3}{8}} \cdot \sqrt[4]{5^3}$. A. $\sqrt[8]{5^9}$ B. $\sqrt[3^2]{5^9}$ C. $\sqrt[1^2]{5^7}$ D. $5^{\sqrt{5^5}}$ Rubric: (1 point) The student correctly selects the equivalent rational or radical form (e.g., D; D; A).			
	Response Type: Multiple Choice, single correct response			



	•						
Task Model 1	Prompt Features: The student gives an example of either an addition or multiplication problem with either a rational or					l	
Response Type:	irrational product or sum.						
Hot Spot	Stimulus Gu	idelines	:				
•	Four or more numbers are given, of which						
DOK Level 2	0	two are	rational nu	umbers ar	nd		
DOR LEVEL 2	0	two are	irrational r	numbers.			
N-RN.3	The ir	rational n	umbers ca	n be π or	of the for	$m a \sqrt[n]{b}$	
Explain why the sum or	where	a is ratio	nal·				
product of two rational	0	h is an ii	nteger suc	h that			
, numbers is rational;	0	<i>b</i> ie an h ■ b	is positive	e when n	is even, aı	nd	
that the sum of a		• b	may be n	egative w	hen <i>n</i> is o	dd; and	
rational number and an	0	n is an v	vhole num	ber such	that $2 \le n$	≤9.	
irrational number is	• Item o	difficulty o	an be adju	usted via	these exa	mple	
product of a popyoro	metho	ods, but a	re not limi	ted to the	ese metho	ds:	
rational number and an	0	radicand	is lead to r	oots that	ao or ao i	not simplir	y to
irrational number is	0	sum/nro	duct of the	e radicano	ts does or	does not	
irrational.	0	lead to r	oots that s	simplify to	a rationa	al number	
	0	integer of	or fraction	coefficier	its may be	added in	
Evidence Required:		front of	the radical	S	-		
1. The student provides	0	radicanc	ls can be v	vhole nun	nbers or fr	actions	
examples of addition or							
multiplication problems	TM1 Stimulus: The student is presented with rational and irrational numbers					d impetions	_1
that will have sums or						11	
products of a specified	numbers.						
type (rational or	Example Stem 1: Click on two numbers whose sum, when						
	added, would be irrational .						
Tools: None				2	1]	
	Numbers	-5	$3\sqrt{2}$	$\frac{2}{2}$	$\frac{1}{2}$	$\sqrt{8}$	
				3	3		
	Example Ste	em 2: Clio	ck on two	numbers	whose su	m, when	
	added, would	l be ratio	nal.				
				2	1		
	Numbers	-5	$3\sqrt{2}$	<u>Z</u>	$\frac{1}{2}$	$\sqrt{7}$	
			-	3	3		
	Example Ste	em 3: Clio	ck on two	numbers	whose pro	oduct, whe	en
	multiplied, w	ould be ir	rational		F.	,	
				2	1		
	Numbers	-5	$3\sqrt{2}$	<u>2</u>	$\frac{1}{2}$	$\sqrt{8}$	
				3	3		



Task Model 1	Example Stem 4: Click on two numbers whose product, when multiplied, would be rational .					
Response Type: Hot Spot	Numbers	-5	$3\sqrt{2}$	$\frac{2}{3}$	$\frac{1}{3}$	$\sqrt{8}$
DOK Level 2	Rubric:					
N-RN.3 Explain why the sum or product of two rational numbers is rational; that the sum of a	(1 point) The conditions. M need to be in responses are	student s ultiple cor cluded in e shown b	selects two rrect respo the scorin pelow.	o numbers onses are g rubric. (s that satis possible a Only exam	sfy the given Ind will all Iple
rational number and an irrational number is irrational; and that the product of a ponzero	Numbers	$\begin{array}{c c} n & 1: \\ \hline -5 & 3\sqrt{2} \\ m & 2: \end{array}$	$\begin{array}{c c} 2\\ \hline 3\\ \hline 3\\ \hline \end{array}$	$\sqrt{8}$		
rational number and an irrational number is	Numbers	$-5 3\sqrt{2}$	$\frac{2}{3}$ $\frac{1}{3}$	$\sqrt{7}$		
	Example Ster	m 3:				
Evidence Required: 1. The student provides	Numbers	- 5 3√2	$\frac{2}{3}$ $\frac{1}{3}$	$\sqrt{8}$		
examples of addition or multiplication problems	on problems Example Stem 4:					
that will have sums or products of a specified	Numbers	- 5 3√2	$\frac{2}{3}$ $\frac{1}{3}$	$\sqrt{8}$		
type (rational or irrational).	Response T	ype: Hot :	Spot			
Tools: None						

N-RN

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Task Model 2

Response Type: Matching Tables

DOK Level 2

N-RN.3

Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Evidence Required:

2. The student determines whether the sum of two numbers is a rational number or an irrational number.

Tools: None

Prompt Features: The student is presented with a list of expressions that contain the sums of rational and/or irrational terms.

Stimulus Guidelines:

- Answer choices include 5 or 6 sums.
 - Irrational numbers can be π or of the form $a\sqrt[n]{b}$ where: \circ *a* is rational;
 - *b* is an integer such that
 - *b* is positive when *n* is even, and
 - b may be negative when n is odd; and
 - o *n* is an whole number such that $2 \le n \le 9$.
- Item difficulty can be adjusted via these example methods, but is not limited to these methods:
 - radicands lead to roots that do/do not simplify to rational numbers;
 - sum/product of the radicands does/does not lead to roots that simplify to a rational number;
 - integer or fraction coefficients may be added in front of the radicands;
 - radicands can be whole numbers or fractions;

TM2a

Stimulus: The student is presented with a list of expressions that contain the sums of rational and/or irrational terms.

Example Stem: Select the appropriate box to identify each expression as having either a rational or irrational sum.

	Rational	Irrational
$5\sqrt{7} + \frac{1}{7}$		
$\sqrt{4} + 17$		
12.4 + (-11)		
$-\frac{4}{5}$ +(-10 $\sqrt{10}$)		

Rubric: (1 Point) The student correctly identifies the sum as rational or irrational (e.g., Irrational, Rational, Rational, Irrational).



Task Model 2

Response Type: Matching Tables

DOK Level 2

N-RN.3

Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Evidence Required:

2. The student determines whether the sum of two numbers is a rational number or an irrational number.

Tools: None

TM2b

Stimulus: The student is presented with a table of numbers.

Example Stem: Select each box in the table where the numbers from corresponding rows and columns will have a **rational** sum.

	4	$\frac{1}{3}$	$\sqrt{3}$	π
4				
$\frac{1}{3}$				
$\sqrt{3}$				
π				

Rubric: (1 Point) The student correctly identifies the sum as rational or irrational (e.g., see below).

	4	$\frac{1}{3}$	$\sqrt{3}$	π
4				
$\frac{1}{3}$				
$\sqrt{3}$				
π				

Response Type: Matching Tables



Task Model 3

Response Type: Matching Tables

DOK Level 2

N-RN.3

Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Evidence Required:

3. The student determines whether the product of two numbers is a rational number or an irrational number.

Tools: None

Prompt Features: The student is prompted to identify products as rational or irrational.

Stimulus Guidelines:

- The irrational numbers can be π or of the form $a^n \sqrt{b}$ where:
 - *a* is rational;
 - \circ *b* is an integer such that
 - *b* is positive when *n* is even, and
 - b may be negative when n is odd; and
 - *n* is an whole number such that $2 \le n \le 9$.
- Item difficulty can be adjusted via these example methods, but is not limited to these methods:
 - radicands lead to roots that do/do not simplify to rational numbers;
 - sum/product of the radicands does/does not lead to roots that simplify to a rational number;
 - integer or fraction coefficients may be added in front of the radicands;
 - \circ $\;$ radicands can be whole numbers or fractions.

ТМЗа

Stimulus: The student is presented with a list of expressions that contain the product of rational and/or irrational terms.

Example Stem: Select the appropriate box to identify each expression as having either a rational or irrational product.

	Rational	Irrational
$5\sqrt{7} \cdot \frac{1}{7}$		
$\sqrt{4} \cdot 17$		
12.4 · (-11)		
$-\frac{4}{5} \cdot (-10\sqrt{10})$		

Rubric: (1 Point) The student correctly identifies the product as rational or irrational (e.g., Irrational, Rational, Rational, Irrational).



Task Model 3

Response Type: Matching Tables

DOK Level 2

N-RN.3

Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Evidence Required:

3. The student determines whether the product of two numbers is a rational number or an irrational number.

Tools: None

TM3b

Stimulus: The student is presented with a table of numbers.

Example Stem: Select each box in the table where the numbers from corresponding rows and columns will have a rational product.

	4	$\frac{1}{3}$	$\sqrt{3}$	$-\sqrt{3}$
4				
$\frac{1}{3}$				
$\sqrt{3}$				
$-\sqrt{3}$				

Rubric: (1 Point) The student correctly identifies the product as rational or irrational (e.g., see below).

	4	$\frac{1}{3}$	$\sqrt{3}$	$-\sqrt{3}$
4				
$\frac{1}{3}$				
$\sqrt{3}$				
$-\sqrt{3}$				

Response Type: Matching Tables



Task Model 3	Prompt Features: Identify which factors would result in a rational product when multiplied by a given a rational or irrational number		
Response Type:			
Multiple Choice,	Stimulus Guidelines:		
single correct	• The irrational numbers can be π or of the form $a^n \sqrt{b}$		
response	where:		
	\circ a is rational;		
DOK Level 1	\circ b is an integer such that		
	b is positive when n is even, and		
N-RN.3	• <i>b</i> may be negative when <i>n</i> is odd; and		
Explain why the sum or	• Item difficulty can be adjusted via these example		
product of two rational	methods, but is not limited to these methods:		
numbers is rational;	 radicands lead to roots that do/do not simplify to 		
that the sum of a	rational numbers;		
rational number and an	 sum/product of the radicands does/does not lead 		
irrational number is	to roots that simplify to a rational number;		
product of a popyoro	 integer or fraction coefficients may be added in function of the subdising day. 		
rational number and an	front of the radicands;		
irrational number is			
irrational.	ТМЗс		
	Stimulus: The student is presented with a rational or irrational		
Evidence Required:	number.		
3. The student	Example Stem: Select all numbers that will produce a rational		
determines whether the	number when multiplied by $7\sqrt{5}$.		
product of two numbers	. 1		
is a rational number or	A. $-\frac{2}{5}$		
an irrational number.	B. $7\sqrt{125}$		
	C. $5 + \sqrt{5}$		
Tools: None	D. $3\sqrt{\frac{9}{5}}$		
	Rubric: (1 point) The student correctly identifies the products as rational (e.g., B, D).		
	Response Type: Multiple Choice, multiple correct response		



Task Model 3	Prompt Features: The student will be prompted to identify sums and products as rational or irrational		
Response Type:	Stimulus Guidelines:		
Matching Tables	• The irrational numbers can be π or of the form $a\sqrt[n]{b}$		
	where:		
DOK Level 1	\circ a is rational;		
	• b is an integer such that		
N-RN.3	 b is positive when n is even, and b may be pagetive when n is odd; and 		
Explain why the sum or	n is an whole number such that $2 < n < 9$		
product of two rational	 Item difficulty can be adjusted via these example 		
numbers is rational;	methods, but is not limited to these methods:		
that the sum of a	\circ radicands lead to roots that do/do not simplify to		
irrational number and an	rational numbers;		
irrational and that the	 sum/product of the radicands does/does not lead to roots that simplify to a rational number; 		
product of a nonzero	$_{\circ}$ integer or fraction coefficients may be added in		
rational number and an	front of the radicands;		
irrational number is	 radicands can be whole numbers or fractions. 		
irrational.			
	TM3d		
Evidence Required:	Stimulus: The student is presented with expressions that		
2. The student			
sum of two numbers is a	Example Stem: Select the appropriate box to identify the value		
rational number or an	of each expression as being rational or irrational.		
irrational number.			
3. The student	$5\sqrt{7} + \frac{1}{7}$		
determines whether the	12.4 · (-11)		
is a rational number or	$\sqrt{4} + 17$		
an irrational number.	$(-10\sqrt{10}) \cdot 10\overline{\sqrt{10}}$		
Tools: None	Rubric: (1 Point) Student correctly identifies all sums and		
	products correctly (e.g., Irrational, Rational, Rational, Rational).		

Response Type: Matching Tables



Task Model 1	Prompt Features: The student is prompted to choose the units of	
	measurement in formulas.	
Response Type: Multiple Choice, single correct	Stimulus Guidelines: Item difficulty can be adjusted via these example methods, but is not limited to these methods:	
response	• One step problems, such as finding units for V in $V = \frac{a}{t}$, given	
DOK Level 1	units for <i>d</i> and <i>t</i> . • Two- or three-step problems, such as finding units for <i>E</i> in $E = mc^2$ given units for <i>m</i> and <i>c</i> .	
N-Q.1 Use units as a way	 Three or more step problems, where not all units are given for all variables. 	
problems and to guide the solution of multi-step problems;	 Problems where units are calculated for a variable in one equation in order to find units for a variable in another given equation in context where units may not be familiar. 	
choose and interpret units consistently in formulas; choose and interpret the	TM1a Stimulus: The student is presented with a formula that uses measurements given in different units.	
scale and the origin in graphs and data displays.	Example Stem: Given the formula, $K = \frac{1}{2}mv^2$ where	
Evidence Required: 1. The student	 <i>K</i> represents kinetic energy, <i>m</i> represents mass and has units of kilograms (<i>kg</i>), and <i>v</i> represents velocity and has units of meters per second (<i>m/s</i>). 	
consistently in formulas.	Select an appropriate measurement unit for kinetic energy.	
Tools: Calculator	A. $\frac{kg m^2}{s}$	
	B. $\frac{kg^2 m^2}{s^2}$	
	C. $\frac{kg}{s^2}$	
	D. $\frac{1}{s^2}$	
	Rubric: (1 point) Student selects the correct response (e.g., D).	
	Response Type: Multiple Choice, single correct response	



Task Model 1 **Prompt Features:** The student is prompted to choose the units of measurement in formulas. **Response Type:** Drag and Drop Stimulus Guidelines: Item difficulty can be adjusted via these example methods, but are not limited to these methods: DOK Level 1 • Two step problems • Three or more step problems N-0.1 Use units as a way TM1b to understand Stimulus: The student is presented with a context in which a number needs converting of units. problems and to guide the solution of multi-step problems; **Example Stem:** The density of water at a certain temperature is 62.4 $\frac{lb}{ft^3}$. choose and interpret units consistently in formulas; choose Drag a rate or quantity from the box to each blank to calculate the and interpret the density of water in units of kilograms per cubic meter, $\frac{kg}{m^3}$. scale and the origin in graphs and data displays. Evidence **Required:** 1. The student chooses units consistently in formulas. 62.4 *lb* 3.28 ft 2.205 kgTools: Calculator 1 kg 3.28 ft 62.4 lb 1 m 2.205 lb $1 ft^3$ 62.4 lb³ $3.28 ft^{3}$ 2.205 lb $1 ft^3$ 1 m 1 kg $\left(\frac{3.28\ ft}{1\ m}\right)^3$ $\left(\frac{1 \, kg}{2.205 \, lb}\right)^3$ $\left(\frac{62.4 \ lb}{1 \ ft}\right)^3$ Interaction: The student drags and drops the correct rate or quantify from the box in order to calculate the density of water in $\frac{kg}{m^3}$. Rubric: (1 point) The student chooses the following correct three rates or quantities (order does not matter): $\frac{62.4 \, lb}{1 \, ft^3}$, $(\frac{3.28 \, ft}{1 \, m})^3$, $\frac{1 \, kg}{2.205 \, lb}$ One such ordering would be: $\frac{62.4 \, lb}{1 \, ft^3} \cdot (\frac{3.28 \, ft}{1 \, m})^3 \cdot \frac{1 \, kg}{2.205 \, lb}$. Response Type: Drag and Drop



Task Model 2	Prompt Features: The student is prompted window for a graph.	to choo	ose the	e graphing
Response Type:				
Matching Tables	Stimulus Guidelines: Item difficulty can be	adjuct	od by	usina
Matching Tables		aujusu		using
_	different types of functions (e.g., linear, quad	ratic, e	etc.)	
DOK Level 2	 Asking students to identify wind 	dows w	here o	certain key
	features would be visible.			
N-0 1				
lles units as a way to	TM2a			
Use units as a way to	Ctimulue: The student is presented with place	atovt.		ation
understand problems	Stimulus: The student is presented with a co	ntextu		ation
and to guide the	where the equation for the function may or m	iay not	be gr	ven.
solution of multi-step				
problems; choose and	Example Stem: A company makes 3,000 lite	ers of i	uice pe	er dav. Let
internet units	v represent the total amount of juice in liters	made	inv	dave
interpret units	y represent the total amount of julce, in iters	, maue		uuys.
consistently in				
formulas; choose and	An equation representing this situation is enter	ered in	to a gi	raphing
interpret the scale and	calculator. Determine whether a graph create	d with	each	calculator
the origin in graphs and	display window defined in the table will show	all poir	nts rer	presenting
	the total amount of juice made in 0 to 7 days	p		
data displays.		•		
	Salact Vac ar No far aach dicplay window			
Evidence Required:	Select res of No for each display willdow.			
2. The student chooses			1	I
the scales for graphs	The calculator display window shows:	Yes	No	
and data displays.	$-100 \le x \le 3,100 \text{ and } -1 \le y \le 8$			
	$-1 \le x \le 8$ and $-100 \le y \le 3,100$			
Tools: Calculator	$-1 \le x \le 8$ and $-100 \le y \le 21,100$			
	$-100 \le x \le 21,100$ and $-100 \le y \le 3,100$			
			1	I
	Pubrice (1 point) The student selects the cor	ract ra	-nonc	for oach
		iectie	sponse	
	display window (e.g., NNYN).			
	Response Type: Matching Tables			



Task Model 2	Prompt Features: The student is prompted to select the fewest quadrants needed to create a graph.
Response Type: Multiple Choice, multiple correct	Stimulus Guidelines: The student is presented with a contextual situation.
response	 Item difficulty can be adjusted via these example methods, but are not limited to these methods: graph fits into one guadrant
	 graph fits into more than one quadrant
N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step	TM2b Stimulus: The student is presented with a contextual situation.
problems; choose and interpret units consistently in	Example Stem 1: Pedro has \$200 saved. He saves an average of \$45 per week.
formulas; choose and interpret the scale and the origin in graphs and	Select as few quadrants as possible that would allow you to create a graph of Pedro's savings, y , after x weeks.
data displays.	A. Quadrant 1 B. Quadrant 2 C. Quadrant 3
2. The student chooses the scales for graphs and data displays.	D. Quadrant 4
Tools: Calculator	Example Stem 2: Carla borrowed \$18,000 to start a business. Her business earnings averaged \$350 per week for the first 10 weeks. Her earnings averaged \$500 for the next 10 weeks. Carla's balance, <i>y</i> , in any week, <i>x</i> , is equal to her total earnings minus the amount she borrowed.
	Select as few quadrants as possible that would allow you to create a graph of Carla's balance over the first 20 weeks.
	A. Quadrant 1 B. Quadrant 2 C. Quadrant 3 D. Quadrant 4
	Rubric: (1 point) The student selects the correct responses (e.g., A; D).
	Response Type: Multiple Choice, multiple correct response



TIS Mathematics Iter	
Task Model 1	Prompt Features: The student is prompted to use the structure of an
Response Type: Multiple Choice, single correct	expression to select the expression that is equivalent to the given expression. Stimulus Guidelines:
response	• Expressions may be:
DOK Level 1	 difference of two squares sum/difference of two cubes the product of two or three expressions
A-SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a	 sum/difference of expressions that have a common factor rational exponential Difficulty level can be altered by varying the type of expression and/or the order of factors in a compound expression, and by using different variables and coefficients.
difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.	TM1a Stimulus: The student is presented with an expression that is a difference of two squares.
Evidence Required: 1. The student uses the structure of an expression to identify ways of rewriting it.	Example Stem: Select the expression that is equivalent to $x^2 - 4$. A. $(x - 2)^2$ B. $(x - 2)(x + 2)$ C. $x^2 + 2x + 4$ D. $x^2 - 2x + 4$
Tools: None	
	Rubric: (1 point) The student selects the correct option (e.g., B).
	Response Type: Multiple Choice, single correct response
	TM1b Stimulus: The student is presented with an expression that is the sum/difference of expressions that have a common factor.
	Example Stem: Select the expression that is equivalent to $(x + 4)^2 - (x - 2)(x + 4)$.
	A. $4(x + 4)$ B. $2(x + 1)(x + 4)$ C. $(x + 4) - (x - 2)$ D. $(x + 4)[(x + 4) - (x - 2)]$
	Rubric: (1 point) The student selects the correct option (e.g., D).
	Response Type: Multiple Choice, single correct response

HS Mathematics Item Specification C1 TD Task Model 1



Response Type:
Matching Tables

TM1c Stimulus: The student is presented with an expression that is a sum/ o cubes.

Example Stem 1: Determine whether each expression is equivalent to $(x^3 + 8)$. Select Yes or No for each expression.

	Yes	Νο
$(x + 2)^3$		
$(x-2)(x^2+2x+4)$		
$(x+2)(x^2-2x+4)$		

Example Stem 2: Determine whether each expression is equivalent to $(8x^3 - 64)$. Select Yes or No for each expression.

	Yes	No
$(2x-4)^3$		
$8(x-8)^3$		
$8(x-2)(x^2+2x+4)$		
$(2x-4)(4x^2+8x+16)$		

Rubric: (1 point) The student selects the correct options (e.g., NNY; NNYY).

Response Type: Matching Tables

lulus.	IIIE	Su	Jue
/differe	ence	of	two

DOK Level 1

A-SSE.2

Evidence Required:

1. The student uses the structure of an expression to identify ways of rewriting it.

Tools: None

.



HS Mathematics Iter	m Specification C1 TD		Assessment Consortium
Task Model 1	Prompt Features: The studer	nt is prompted to us	e the structure of
	expressions to determine if tw	o expressions are eq	juivalent.
Response Type:	Chiman Caridalin a sa		
Matching Tables	Stimulus Guidelines:		
	Equivalences consist of involve:	equations of expres	sions, which may
DOK Level 2	\circ difference of two	squares	
	\circ sum/difference of	of two cubes	
A-SSE.2	 the product of ty 	vo or three expressi	ons
Use the structure of an	 sum/difference of 	of expressions that h	nave a common factor
expression to identify	 rational express 	ions	
ways to rewrite it. For	o exponential exp	ressions	
example, see $x^2 - y^2$	 Difficulty level can be a and/or the order of fact 	itered by varying the	e type of expression
as(x) = (y), thus recognizing it as a	variables and coefficien	te	and by using unreferit
difference of squares	valiables and coefficient		
that can be factored as	TM1d		
$(x^2 - y^2)(x^2 + y^2).$	Stimulus: The student is pres	ented with four equa	ations.
Evidence Required:	Example Stem 1: Determine	if each equation is t	rue for all values of x.
1. The student uses	Select Yes or No for each equa	tion.	
expression to identify			
ways of rewriting it.		Yes	No
Tools: None	$x^2 + 4 = (x + 2)^2$		
	$(2x+6)^2 = 4(x+3)^2$		
	$(x-3)(x-3) = (x-9)^2$		
	$x^2 - 10x + 25 = (x - 5)(x + 5)$		
	Example Stem 2: Determine	if each equation is t	rue for all values of x .
		Yes	Νο
	$2^{3x} = 6^x$		
	$100^x = 10^{2x}$		
	$e^x \cdot e^x = e^{2x}$		
	$2^{10x} = 10^{2x}$		

Rubric: (1 point) The student selects the correct options (e.g., NYNN; NYYN).

Response Type: Matching Tables

HS Mathematics Item Specification C1 TD Task Model 1



	rational expression to create an expression that is equivalent to the
Response Type: Drag	given expression.
and Drop	

DOK Level 2

Use the structure of an

A-SSE.2

Stimulus Guidelines:

- Equivalences consist of equations of rational expressions.
- Difficulty level can be altered by varying the complexity of the equations, the type of rational expressions, and by using different variables and coefficients.





Task Model 1 **Prompt Features:** The student is prompted to use the structure of an expression to create an expression that is equivalent to the given **Response Type:** expression. **Drag and Drop** Stimulus Guidelines: **DOK Level 2** Equivalences consist of equations of expressions. • Expressions may be: A-SSE.2 difference of two squares Use the structure of an sum/difference of two cubes expression to identify • the product of two or three expressions ways to rewrite it. For • sum/difference of expressions that have a common factor example, see $x^4 - y^4$ o rational $as (x^2)^2 - (y^2)^2$, thus • exponential recognizing it as a • Difficulty level can be altered by varying the type of expression difference of squares and/or the order of factors in a compound expression, and by that can be factored as using different variables and coefficients. $(x^2 - y^2)(x^2 + y^2).$ TM1f **Evidence Required: Stimulus:** The student is presented with two equivalent expressions 1. The student uses with missing numbers that may be found using structure without the structure of an carrying out the calculation. expression to identify ways of rewriting it. **Example Stem 1:** Drag a number into each box to create an equation that is true for all values of x. Tools: None $2(4x+3)(3x+5) = x^2 + 58x + x^2$ Palette Choices: 6 8 12 15 24 29 30 58 **Example Stem 2:** Drag a number into each box to create an equation that is true for all values of x. $\frac{3(n+2)(4n+1)}{6} = \boxed{n^2 + \frac{9}{2}n} + \boxed{n}$ **Palette Choices:** $\frac{1}{6}$ $\frac{1}{3}$ $\frac{1}{2}$ 1 2 4 6 12 **Example Stem 3:** Drag a number into the box to create an equation that is true for all values of x. $(x+2)^2 - 5 = x^2 + 4x + \boxed{}$ **Palette Choices: -4 -1 4 9**



Response Type: Drag and Drop **Example Stem 4:** Drag a number into the box to create an equation that is true for all values of *x*.

Example Stem 5: Drag a number into the box to create an equation

 $(x-10)(x+12) = 3(x+1)^2 - 363$

$$(x-7)^2 + 51 = x^2 + \Box x + 100$$

DOK Level 2

Task Model 1

A-SSE.2

Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.

Evidence Required:

1. The student uses the structure of an expression to identify ways of rewriting it.

Tools: None

Palette Choices: -12, -1, 1, 3, 10

Rubric: (1 point) The student places the correct number in the box(es). Example Stem 1: 24, 30; Example Stem 2: 2, 1; Example Stem 3: -1; Example Stem 4: -14; Example Stem 5: 3.

Response Type: Drag and Drop

Palette Choices: -14, 0, 2, 14, 49

that is true for all values of x.



Task Model 1	Prompt Features: The student identifies the factored form of an		
Response Type:	expression as best for revealing zeros and chooses the zeros.		
Hot Spot	Stimulus Guidelines:		
DOK Level 2	 All numbers, variables, and operations should be changed to create an item. 		
	 Difficulty level can be altered by varying the type of 		
A-SSE.3a Choose and produce an	expression, and by using different variables and coefficients		
equivalent form of an			
expression to reveal and explain properties	TM1a Stimulus: The student is presented with equivalent quadratic		
of the quantity	equations for f(x).		
represented by the expression.	Example Stem:		
a. Factor a quadratic	Part A: Three equivalent equations for $f(x)$ are shown. Select the		
expression to reveal the zeros of the	form that reveals the zeros of $f(x)$ without changing the form of the equation.		
function it defines.	Part D. Calact all values of a familiah f(v)		
Evidence Required:	Part B: Select all values of x for which $f(x) = 0$.		
1. The student	Davit A		
factored form of a	$f(x) = -2x^2 + 24x - 54$		
quadratic expression	f(x) = -2(x - 3)(x - 9)		
function it defines.	f(x) = 2(x - 3)(x - 3)		
Tools: None	$f(x) = -2(x-6)^2 + 18$		
	Part B:		
	F4 18 0 6 3		
	0 5 0 9 18 54		
	Rubric:		
	(1 point) The student selects the correct equation for $f(x)$ and		
	selects the correct zeros.		







Task Model 1	Prompt Features: The student identifies the standard form of a quadratic expression as best for finding the value of $f(x)$ when
Response Type: Hot Spot	x = 0.
•	Stimulus Guidelines:
DOK Level 2	 All numbers, variables, and operations should be changed to create an item
A CCE 2-	lo create an item.
A-SSE.3a Choose and produce an equivalent form of an	• Difficulty level can be altered by using different variables and coefficients.
expression to reveal	TM1b
and explain properties	Stimulus: The student is presented with equivalent quadratic
of the quantity represented by the	expressions for $f(x)$.
expression.	Example Stem:
a. Factor a quadratic	Part A: Three equivalent equations for $f(x)$ are shown. Select the
expression to reveal	form that reveals the value of $f(x)$ when $x=0$ without changing the
the zeros of the function it defines.	form of the equation.
	Part B: Select the value of $f(x)$ when $x = 0$.
Evidence Required:	
1. The student	
understands that the	
factored form of a	Part A:
quadratic expression	$f(x) = -2x^2 + 24x - 54$
reveals the zeros of the	
function it defines	f(x) = -2(x - 3)(x - 9)
function it defines.	
Tools: None	$f(x) = -2(x-6)^2 + 18$
	Part B:
	-54 -18 -9 -6 -3
	-54 -16 -5 -6 -5
	0 3 6 9 18 54
	Rubric:
	(1 point) The student selects the correct equation for $f(x)$ and
	selects the correct value for $f(x)$ when $x = 0$.







Task Model 2	Prompt Features: The student identifies the form of a given quadratic expression that reveals the maximum or minimum of the	
Response Type: Hot Spot	expression and chooses the maximum or minimum value of that expression.	
DOK Level 2	Stimulus Guidelines: • The completed square form is $p(x - h)^2 + k$ knowing that	
A-SSE.3b Choose and produce an equivalent form of an expression to reveal	 The completed square form is a(x = n) + k, knowing that h = -b/2a and k = c - b²/4a Difficulty level can be altered by using different variables and coefficients. 	
and explain properties of the quantity represented by the expression.	TM2a Stimulus: The student is presented with equivalent quadratic equations for $f(x)$.	
a. Complete the square in a quadratic expression to reveal the maximum or	Example Stem: Part A: Three equivalent equations for $f(x)$ are shown. Select the form that reveals the maximum value of $f(x)$ without changing the form of the equation.	
minimum value of the function it defines.	Part B: Select the maximum value of $f(x)$.	
Evidence Required:	Part A: $f(x) = -2x^2 + 24x - 54$	
understands that	f(x) = -2(x - 3)(x - 9)	
for a quadratic expression reveals the maximum or minimum	$f(x) = -2(x-6)^2 + 18$	
defines.	Part B:	
Tools: None	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	
	Rubric: (1 point) The student selects the correct equation for $f(x)$ and selects the maximum value.	







Task Model 2	Prompt Features: The student identifies the form of a given guadratic expression that reveals the maximum or minimum of the
Response Type:	expression.
Multiple Choice,	Shimulua Cuidalinaa
	• The completed square form is $2(r-h)^2 + k$ knowing that
response	$h = -b/2a$ and $k = c - b^2/4a$.
DOK Level 1	 Difficulty level can be altered by using different variables and coefficients.
A-SSE.3b	
Choose and produce an	TM2b
equivalent form of an expression to reveal	Stimulus: The student is presented with four quadratic equations.
and explain properties	Example Stem: Which equation reveals the minimum or
of the quantity	maximum value of $f(x)$ without changing the form of the equation?
represented by the	
expression.	A. $f(x) = (x-1)^2 - 4$
square in a	B. $f(x) = x^2 - 2x - 3$
quadratic	C. $f(x) = x^2 - 3x + x - 3$
expression to reveal the maximum or	D. $f(x) = (x+1)(x-3)$
minimum value of	Pubric: (1 point) The student correctly chooses the form that
the function it	reveals the maximum or minimum of the guadratic function (e.g.,
defines.	A).
Evidence Required:	, , , , , , , , , , , , , , , , , , ,
2. The student	Response Type: Multiple Choice, single correct response
understands that	
for a quadratic	
expression reveals the	
maximum or minimum	
value of the function it	
ueimes.	
Tools: None	



Task Model 2	Prompt Features: The student completes the square for a quadratic expression to reveal the maximum or minimum of the
Response Type: Equation/Numeric	expression.
· · · · · · · · · · · · · · · · · · ·	Stimulus Guidelines
DOK Level 2	• The completed square form which is $a(x - h)^2 + k$, knowing that $h = -b/2a$ and $k = c - b^2/4a$
A-SSE.3b Choose and produce an	 Difficulty level can be altered by using different variables and coefficients.
equivalent form of an	TMD
of the quantity represented by the	standard form.
expression. a. Complete the	Example Stem 1: Enter the function $f(x) = x^2 - 7x - 18$, in the form $f(x) = a(x - h)^2 + k$, where a, h, and k are constants.
quadratic expression to reveal	Enter your answer in the first response box.
the maximum or minimum value of the function it	Enter the x-coordinate of the minimum value of the function in the second response box.
defines.	
Evidence Required:	Example Stem 2: Enter the function $f(x) = 28x^2 + 16x - 80$, in the form $f(x) = a(x - h)^2 + k$, where a, h, and k are constants.
2. The student	
understands that	Enter your answer in the first response box.
completing the square	
for a quadratic	Enter the <i>x</i> -coordinate of the minimum value of the function in the
expression reveals the	second response box.
maximum or minimum	
value of the function it	
defines.	Rubric:
	(2 points) The student correctly enters the function in the
Tools: None	equivalent form and enters the x-coordinate of the maximum
	value of the function [e.g., $f(x) = \left(x - \frac{7}{2}\right)^2 - \frac{121}{4}$ and $\frac{7}{2}$;
	$28\left(x+\frac{2}{\pi}\right)^2-\frac{576}{\pi}$ and $-\frac{2}{\pi}$].
	(1 point) The student correctly enters the function in the
	of the function [e.g., $f(x) = \left(x - \frac{7}{2}\right)^2 - \frac{121}{2}$ or $\frac{7}{2}$;
	$(2)^2 576 2^2$
	$28(x+\frac{2}{7}) -\frac{375}{7}$ or $-\frac{2}{7}$].
	Response Type: Equation/Numeric (two response boxes)





Task Model 3	Prompt Features: The student uses the properties of exponents	
Deenenge Turner	to produce an equivalent expression for an exponential expression	
Response Type: Equation/Numeric:	as specified in the stem).	
DOK Level 2	Stimulus Guidelines:	
A-SSE.3c Use the properties of exponents to transform expressions for exponential functions. For example, the	 Exponential algebraic expressions with one or more variables, integer and rational coefficients, and rational exponents involving operations of addition, subtraction, multiplication, and division Difficulty level can be altered by using different variables and exponents. 	
expression 1.15^t can be rewritten as $\approx 1.012^{12t}$ to reveal the approximate equivalent	TM3a Stimulus: The student is presented with an exponential expression and the form in which it is to be transformed.	
monthly interest rate if the annual rate is 15%.	Example Stem 1: Enter an expression equivalent to $\left(\frac{a^9}{a^3}\right)$ in the form, a^m .	
Evidence Required: 3. The student uses the properties of exponents to transform exponential	Example Stem 2: Enter an expression equivalent to a^{20} in the form, $(a^n)^m$.	
expressions.	Example Stem 3: Enter an expression equivalent to a^{-12} in the form $(a^n)^m$	
Tools: None		
	Example Stem 4: Enter an expression equivalent to $(a^2a^4b)^5$ in the form, a^mb^n .	
	Rubric: (1 point) The student correctly enters an equivalent expression in the given form [e.g., a^6 ; $(a^4)^5$; $(a^{-3})^4$; $a^{30}b^5$].	
	Multiple correct answers may be possible for some items.	
	Response Type: Equation/Numeric	


Task Model 3	Prompt Features: The student is prompted to use the properties of exponents to transform exponential expressions.				
Response Type: Multiple Choice,	Stimulus Guidelines:				
single correct	 All numbers, variables, and operations should be changed to create an item 				
	 Difficulty level can be altered by using different variables 				
DOK Level 2	and coefficients.				
A-SSE.3c	ТМЗЬ				
Use the properties of exponents to transform	Stimulus : The student is presented with a contextual situation and an exponential expression representing an exponentially				
expressions for	increasing or decreasing quantity within the given situation.				
For example, the	Example Stem: This expression defines a function that models				
expression 1.15^t can be rewritten as $\approx 1.012^{12t}$	the future population of wolves in a park after <i>t</i> years.				
to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.	$3280(1.15)^t$				
	Which expression best defines the function that represents the				
	wolf population after x months?				
Evidence Required: 3. The student uses the properties of exponents to transform exponential	A.3280(1.0125) ^x				
	$B.3280(1.0117)^x$				
	$C.3280(1.12)^x$				
	$D.3280(1.2)^x$				
expressions.	Pubric: (1 point) Student selects the correct expression (e.g., \mathbb{R})				
Tools: Calculator	NUMBER (1 point) Student selects the correct expression (e.g., b).				
	Response Type: Multiple Choice, single correct response				



Task Model 3	Prompt Features: The student is prompted to use the properties				
	of exponents to transform exponential expressions to find the				
Response Type:	growth or decay rate for different units of time.				
Equation/Numeric					
	Stimulus Guidelines:				
DOK Level 2	 All numbers, variables, and operations should be changed to create an item. 				
A-SSE.3c	 Difficulty level can be altered by using different variables 				
Use the properties of	and coefficients.				
exponents to transform					
expressions for	ТМЗс				
exponential functions.	Stimulus : The student is presented with a contextual situation				
For example, the	and an exponential expression representing an exponentially				
expression 1.15° can be	increasing or decreasing quantity within the given situation.				
rewritten as $\approx 1.012^{121}$					
to reveal the	Example Stem: This expression defines a function that models				
monthly interest rate if	the future population of worves in a park after x months.				
the annual rate is 15%	3280(1 0117) ^x				
Evidence Required:	Enter the yearly growth rate for the wolf population as a percent.				
3. The student uses the	Round to the nearest hundredth.				
properties of exponents					
to transform					
exponential	Rubric:				
expressions.	(1 point) Student produces the correct growth or decay rate (e.g., 14.98%).				
Tools: Calculator					
	Response Type: Equation/Numeric				



Task Model 1	Prompt Features: The student is prompted to enter an equivalent expression. The equation is created from determining the sum or				
Response Type: Equation/Numeric	difference of the polynomials in the given expression.				
DOK Level 2	 Stimulus Guidelines: Item difficulty can be adjusted via these example methods, but are not limited to these methods: Two or more multivariate monomials where at least two 				
A-APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.	 have the same variables and powers (e.g, 3x²y + 7x²y), Two or more single variable polynomials (including monomials) where all the terms are degree 2 or less (e.g (6x² + 7x) + (4x² - 3x)), Two or more multivariate polynomials (including monomials) where at least two have terms with the same variables and powers and all the terms are degree 2 or less, or Two or more multivariate polynomials (including monomials) of any degree where at least two have terms with the same variables and powers. 				
Evidence Required: 1. The student adds or subtracts polynomials.	TM1 Stimulus: The student is presented with an expression involving the addition and/or subtraction of polynomials.				
Tools: None	Example Stem 1: Enter an expression equivalent to $(4x^2 - 5x + 6) + (9x^2 - 2x) - (11x - 3)$ using the fewest number of possible terms.				
	Example Stem 2: Enter an expression equivalent to $(4x^2 - 5yz + 6) - (9x^2 - 2z) + (11yz - 3)$ using the fewest number of possible terms.				
	Rubric: (1 point) The student enters a correct expression (e.g., $13x^2 - 18x + 9$, $-5x^2 + 6yz + 2z + 3$).				
	Response Type: Equation/Numeric				



Task Model 2	Prompt Features: The student is prompted to enter an equivalent expression. The equation is created from determining the product				
Response Type: Equation/Numeric	or quotient of the polynomials in the given expression.				
DOK Level 2 A-APR.1	 Stimulus Guidelines: Item difficulty can be adjusted via these example methods, but are not limited to these methods: Two or more multivariate monomials, Two or more single variable polynomials (including monomials) where all the terms are degree 2 or less 				
polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction,	 Two or more multivariate polynomials (including monomials) where all the terms are degree 2 or less, or Two or more multivariate polynomials (including monomials) of any degree. 				
and multiplication; add, subtract, and multiply polynomials.	TM2 Stimulus: The student is presented with an expression involving the product of polynomials.				
Evidence Required: 2. The student multiplies polynomials.	Example Stem 1: Enter an expression equivalent to $9x^2y(-8x^2y)$ in the form Ax^my^n .				
Tools: None	Example Stem 2: Multiply and combine like terms to determine the product of these polynomials.				
	(2x-3)(5x+6)				
	Enter your result in the response box.				
	Example Stem 3: Multiply and combine like terms to determine the product of these polynomials.				
	$(4x^2 - 5xy + 6)y(5x + 6)$				
	Enter your result in the response box.				
	Example Stem 4: Multiply and combine like terms to determine the product of these polynomials.				
	(4x+1)(x+6)(x-2)				
	Enter your result in the response box.				
	Rubric: (1 point) The student correctly multiplies and combines like terms (e.g., $-72x^4y^2$; $10x^2 - 3x - 18$; $20x^3y + 24x^2y - 25x^2y^2 - 30xy^2 + 30xy + 36y$; $4x^3 + 17x^2 - 44x - 12$).				
	Response Type: Equation/Numeric				



Task Model 1	Prompt Features: The student is prompted to create a one						
	variable equation that can be used to solve a given problem.						
Response Type:							
Equation/Numeric	Stimulus Guidelines:						
-	• The student is presented with a contextual situation familiar to						
DOK Level 2	16 to 17 year olds that:						
DOR LEVEL 2	\circ can be modeled by a function equal to a given value						
A-CED.1	 The unknown value of a quantity is represented as a 						
Create equations and	multivariable equation with various parameters given in						
inequalities in one	context.						
variable and use	$\circ~$ The equations reduce to one variable linear, quadratic,						
them to solve	simple rational, or exponential equations.						
problems Include	 Item difficulty can be adjusted via these example methods, but 						
ogustions prising	is not limited to those methods:						
from linear and	 The form of the equation being created: 						
quadratic functions	 is linear 						
and simple rational	 is quadratic 						
and exponential	 is simple rational 						
functions.	 is exponential 						
	 The complexity of the contextual situation: 						
Fyidence Required	 The unknown variable is referenced directly in the 						
1 The student	contextual cituation						
reates and variable	The guantity in relation is the unknown variable						
	• The quantity in relation is the unknown variable.						
equations arising	I ne quantity in relation is not the unknown variable, but						
from linear,	rather an expression involving that variable.						
quadratic, simple							
rational, and	TM1						
exponential functions	Stimulus: The student is presented with a contextual problem.						
in one variable.							
	Example Stem 1: Consider the equation that models a train's						
Tools: Calculator	distance from its departing station, where:						
	• v represents the distance in miles						
	• x represents the speed of the train in miles per hour and						
	• t represents the time traveled from the departing station in						
	• Trepresents the time traveled from the departing station in						
	nours.						
	y = xt						
	Entry an equation for which the colution is the encod of the turin in						
	Enter an equation for which the solution is the speed of the train, in						
	miles per hour, where the train's distance from the departing						
	station is 162 miles and it has traveled for 3 hours.						
	Rubric: (1 point) The student correctly enters an equation (e.g.,						
	equation equivalent to $x = 54$).						
	Response Type: Equation/Numeric						

Rubric: (1 point) The student correctly enters an equation (e.g.,

DOK Level 2	 <i>m</i> represents the coefficient of friction between the tires and the road 				
A-CED.1	and the road.				
Create equations and inequalities in one variable and use	$d = vs + \frac{v^2}{64m}$				
them to solve problems. <i>Include</i> equations arising from linear and quadratic functions	Enter an equation for which the solution is the speed, in feet per second, of an automobile with a stopping distance of 200 feet, a driver's response time of 0.5 second, and a coefficient of friction equal to 0.8.				
and simple rational and exponential functions.	Rubric: (1 point) The student correctly enters an equation (e.g., equation equivalent $\frac{v^2}{51.2} + \frac{v}{2} = 200$).				
Evidence Required: 1. The student creates one variable	Example Stem 3: A sales clerk's daily earnings include \$125 per day plus commission equal to x % of his daily sales.				
equations arising from linear, quadratic, simple rational, and	Enter an equation that can be used to find the commission percentage (x) , if the clerk's daily sales are \$1375 and his total earnings for that day are \$180.				
exponential functions in one variable.	Rubric: (1 point) The student correctly enters an equation [e.g., $x = \frac{(180-125)}{1375}(100)$].				
Tools: Calculator	1975				
	Example Stem 4: Jim can paint a house in 12 hours. Alex can paint the same house in 8 hours.				
	Enter an equation that can be used to find the time in hours, t , it would take Alex and Jim to paint the house together.				

stopping distance, *d*, in feet, for an automobile, where:

before applying the brakes, and

v represents the automobile speed, in feet per second,

s represents the driver's response time, in seconds,

Response Type: Equation/Numeric

Task Model 1

HS Mathematics Item Specification C1 TG

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•

 $\frac{1}{12} + \frac{1}{8} = \frac{1}{t}$).

Response Type: Equation/Numeric

5





Task Model 2	Prompt Features: The student is prompted to create a one					
Bachanca Tyray	variable inequality and then use the inequality that can be used to					
Equation /Numeric	solve a given problem.					
Equation/Numeric	Stimulus Guidelines:					
DOK Level 2	 The student is presented with a contextual situation familiar 					
DOR Level 2	to 16 to 17 year olds that:					
	\circ can be modeled by a function greater than less than					
Croate equations and	areater than or equal to or loss than or equal to a					
inequalities in one	given value					
variable and use	 The unknown value of a quantity is represented as a 					
them to solve	multivariable equation with various parameters given					
problems <i>Include</i>	in context					
equations arising	 The inequalities reduce to one variable linear 					
from linear and	 Item difficulty can be adjusted via these example methods, 					
quadratic functions						
and simple rational	but is not limited to these methods:					
and exponential	• The form of the inequality being created:					
functions.	 is linear 					
	 is guadratic 					
Evidence Required:	 is simple rational 					
2. The student	 The complexity of the contextual situation: 					
creates one variable	 The unknown variable is referenced directly 					
inequalities arising	in the contextual situation.					
from linear,	 The quantity in relation is the unknown 					
quadratic, simple	variable.					
rational, and	 The quantity in relation is not the unknown 					
exponential functions	variable, but rather an expression involving					
in one variable.	that variable.					
	TMO					
Tools: Calculator	Stimulus: The student is presented with a contextual situation					
	Contextual situation.					
	Example Stem 1: A clerk earns \$125 per day, plus a commission equal to 10% of her sales, <i>s</i> . The clerk earns less than \$180 on Monday.					
	Enter an inequality that represents all possible values for the clerk's					
	Rubric: (1 point) The student correctly enters the inequality [e.g., inequality equivalent to $s < 10(180 - 125)$]. Example Stem 2: A rectangular garden measuring 13 meters by					
	15 meters is to have a gravel pathway of constant width built all					
	around it. There is enough gravel to cover 80 square meters.					
	Enter an inequality that represents all possible widths (w), in					
	meters, of the pathway.					
	Dubrie					
	KUDFIC:					
	(1 point) The student correctly enters an inequality equivalent to $(13 + 2w)(15 + 2w) - 13(15) \le 80.$ Response Type: Equation/Numeric					



Task Model 3	Prompt Features: The student is prompted to create a graph from a contextual situation						
Response Type:							
Graphing	Stimulus Guidelines:						
	 The student is presented with a contextual situation familiar 						
DOK Level 2	to 16 to 1/ year olds that:						
	 can be modeled as a function equal to a given value The unknown value of a quantity is represented as a 						
A-CED.2 Create equations in	 The unknown value of a quality is represented as a multivariable equation with various parameters given 						
two or more variables	in context						
to represent	 Item difficulty can be adjusted via these example methods. 						
relationships between	but is not limited to these methods:						
quantities; graph	 The form of the equation being created: 						
equations on	is linear						
coordinate axes with	 is quadratic 						
labels and scales.	 Is simple rational is exponential 						
Evidence Required	\sim The complexity of the contextual situation:						
Evidence Required	 The complexity of the contextual Situation: The unknown variable is referenced directly 						
3. The student graphs	in the contextual situation.						
equations on the	 The quantity in relation is the unknown 						
coordinate axes with	variable.						
labels and scales to	 The quantity in relation is not the unknown variable, but rather an expression involving 						
to a contextual	that variable						
problem.							
	ТМЗ						
Tools: Calculator	Stimulus: The student is presented with a contextual						
	situation and a labeled coordinate grid.						
	Example Stem: A school is having T-shirts printed. Scott's T-shirts charges \$150 to set up the printing, and then \$5 per T-shirt.						
	Barbara's 1-shirts charges \$200 to set up the printing and then						
	Use the Add Arrow tool to represent functions that show the cost of buying <i>n</i> T-shirts from each store.						
	T-Shirt Costs						
	400						
Number of Shirts							





HS Mathematics Item Specification C1 TG Assessment Consortiun Task Model 4 Prompt Features: The student is prompted to create an equation



	in two or more variables that can be used to solve a given problem.					
Response Type:						
Equation/Numeric	Stimulus Guidelines:					
	• The student is presented with a contextual situation familiar					
DOK Level 1	to 16 to 1/ year olds that:					
	 can be modeled by an equation The upknown value of a guartity is represented as a 					
A-CED.1	 The unknown value of a quantity is represented as a multivariable equation with various parameters size 					
create equations and	in context					
variable and use	III context.					
them to solve	but is not limited to these methods:					
problems. Include	• The form of the equation being created:					
equations arising	 is linear 					
from linear and	 is quadratic 					
quadratic functions	 is simple rational 					
and simple rational	 is exponential 					
and exponential	• The complexity of the contextual situation:					
functions.	 The unknown variable is referenced directly 					
Evidence Dequired	In the contextual situation.					
4 The student	 The quantity in relation is the unknown variable 					
4. The student	 The quantity in relation is not the unknown 					
two or more variables	variable, but rather an expression involving					
to represent	that variable.					
relationships between	 The number of variables in the equation. 					
quantities.						
	Stimulus: The student is presented with a contextual situation					
Tools: Calculator						
	Example Stem 1: Malik and Nora are playing a video game.					
	• Malik starts with <i>m</i> points and Nora starts <i>n</i> points.					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. 					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. Finally, Nora gets a bonus and her score is doubled. 					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. Finally, Nora gets a bonus and her score is doubled. Nora now has 50 more points than Malik. 					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. Finally, Nora gets a bonus and her score is doubled. Nora now has 50 more points than Malik. 					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. Finally, Nora gets a bonus and her score is doubled. Nora now has 50 more points than Malik. Enter an equation expressing the fact that Nora now has 50 more points than Malik.					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. Finally, Nora gets a bonus and her score is doubled. Nora now has 50 more points than Malik. Enter an equation expressing the fact that Nora now has 50 more points than Malik. Rubric: (1 point) The student correctly enters the equation [e.g.,					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. Finally, Nora gets a bonus and her score is doubled. Nora now has 50 more points than Malik. Enter an equation expressing the fact that Nora now has 50 more points than Malik. Rubric: (1 point) The student correctly enters the equation [e.g., equation equivalent to 2(n - 50) = (m + 150) + 50].					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. Finally, Nora gets a bonus and her score is doubled. Nora now has 50 more points than Malik. Enter an equation expressing the fact that Nora now has 50 more points than Malik. Rubric: (1 point) The student correctly enters the equation [e.g., equation equivalent to 2(n - 50) = (m + 150) + 50]. Example Stem 2: A customer pays <i>c</i> dollars to rent a car for one day plus <i>m</i> dollars per mile. The cost of pacoline is included in the part of the student is part of the student of the part of th					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. Finally, Nora gets a bonus and her score is doubled. Nora now has 50 more points than Malik. Enter an equation expressing the fact that Nora now has 50 more points than Malik. Rubric: (1 point) The student correctly enters the equation [e.g., equation equivalent to 2(n - 50) = (m + 150) + 50]. Example Stem 2: A customer pays <i>c</i> dollars to rent a car for one day plus <i>m</i> dollars per mile. The cost of gasoline is included in the value of <i>c</i> .					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. Finally, Nora gets a bonus and her score is doubled. Nora now has 50 more points than Malik. Enter an equation expressing the fact that Nora now has 50 more points than Malik. Rubric: (1 point) The student correctly enters the equation [e.g., equation equivalent to 2(n - 50) = (m + 150) + 50]. Example Stem 2: A customer pays <i>c</i> dollars to rent a car for one day plus <i>m</i> dollars per mile. The cost of gasoline is included in the value of <i>c</i> . Enter an equation for the total cost, <i>t</i> , to rent the car for one day and drive <i>d</i> miles.					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. Finally, Nora gets a bonus and her score is doubled. Nora now has 50 more points than Malik. Enter an equation expressing the fact that Nora now has 50 more points than Malik. Rubric: (1 point) The student correctly enters the equation [e.g., equation equivalent to 2(n - 50) = (m + 150) + 50]. Example Stem 2: A customer pays <i>c</i> dollars to rent a car for one day plus <i>m</i> dollars per mile. The cost of gasoline is included in the value of <i>c</i> . Enter an equation for the total cost, <i>t</i> , to rent the car for one day and drive <i>d</i> miles. Rubric: (1 point) The student correctly enters the equation (e.g., equation equivalent to <i>t</i> = <i>c</i> + <i>md</i>).					
	 Malik starts with <i>m</i> points and Nora starts <i>n</i> points. Then Malik gets 150 more points, while Nora loses 50 points. Finally, Nora gets a bonus and her score is doubled. Nora now has 50 more points than Malik. Enter an equation expressing the fact that Nora now has 50 more points than Malik. Rubric: (1 point) The student correctly enters the equation [e.g., equation equivalent to 2(n - 50) = (m + 150) + 50]. Example Stem 2: A customer pays <i>c</i> dollars to rent a car for one day plus <i>m</i> dollars per mile. The cost of gasoline is included in the value of <i>c</i> . Enter an equation for the total cost, <i>t</i> , to rent the car for one day and drive <i>d</i> miles. Rubric: (1 point) The student correctly enters the equation (e.g., equation equivalent to <i>t</i> = <i>c</i> + <i>md</i>).					



TIS Machematics Item					
Task Model 1	Prompt Features: Enter the solution to a rational or radical equation.				
Response Type:	Stimulus Guidelines:				
Equation/numeric	Equations cannot have no solutions.				
•	Solutions must be rational numbers.				
DOK Levels 1, 2	 Equations should not have extraneous roots. Item difficulty can be adjusted via these example methods, but are not limited to these methods: 				
A-REI.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	TM1a Stimulus: The stem will present on only one side of the equation • Multiple rational quantities on both sides of the equation • Multiple rational quantities with differing denominators • radicals of the form \sqrt{ax} where <i>a</i> is a constant and <i>x</i> is a variable • radicals of the form $\sqrt{ax+b}$ where <i>a</i> and <i>b</i> are constants and <i>x</i> is a variable TM1a Stimulus: The stem will present a rational equation in one variable with exactly one real solution (limit responses to those that can be expressed by rational numbers). Example Stem 1 (DOK 1): Enter the value of <i>x</i> that makes the equation true. $\frac{1}{x} = 5$ Rubric: (1 point) The student enters the correct value of <i>x</i> (e.g., $\frac{1}{s}$). Example Stem 2 (DOK 2): Enter the value of <i>x</i> that makes the equation true. $\frac{1}{x-4} = \frac{3}{x}$ Rubric: (1 point) The student enters the correct value of <i>x</i> (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.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	Rubric: (1 point) The student enters the correct solution(s) (e.g., 64).
	Example Stem 2 (DOK 2): Enter the value(s) of x that make the equation true.
	$x - 1 = \sqrt{5x - 9}$
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).	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
Tools: None	



HS Mathematics Item	Specification (C1 TH		Assessment Consortiu	
Task Model 1	Prompt Features: Give the number of real solutions to a rational or radical equation.				
Response Type: Matching Tables DOK Level 2	 Stimulus Guidelines: Solutions, if any, must be rational numbers. Item difficulty can be adjusted via these example methods, but are not limited to these methods: variable is present on only one side of the equation 				
A-REI.2 Solve simple rational and radical equations in one variable and give examples showing how extraneous solutions may arise.	 or variable is present on only one side of the equation multiple rational quantities on both sides of the equation Multiple rational quantities with differing denominators radicals of the form √ax where a is a constant and x is a variable radicals of the form √ax+b where a and b are constants and x is a variable 				
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	 TM1c Stimulus: A table with three equations in one variable, where at least two are rational or radical. Example Stem 1: Select whether each equation has no real solution, one real solution, or infinitely many real solutions. 				
exist for the equation (e.g., one, two, infinite, or no real).		No Real Solution	One Real Solution	Infinitely Many Real Solutions	
Tools: None	$\sqrt{x} + 2 = 0$				
	$\frac{10}{x} = \frac{20}{x+20}$				
	$\frac{3}{x} = \frac{2}{x+1}$				
	Rubric: (1 point for each equatio Real Solution). Response Type	:) The student ch n (e.g., No Real e: Matching Table	nooses the corre Solution, One R	ct classification eal Solution, One	



Task Model 1

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

Response Type:	
Matching Tables	

DOK Level 2

A-REI.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
$\sqrt{x} + 2 = 0$			
$\sqrt{x^2 - 5} = 2$			
$\frac{3}{x} = \frac{2}{x+1}$			

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, or infinitely many real solutions.

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

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



HS Mathematics Item	Specification C1 TH	Assessment Consortiu
Task Model 1	Prompt Features: Select solutions t equation.	to a given rational or radical
Response Type: Matching Tables DOK Level 1	 Stimulus Guidelines: Solutions must be rational number of the second secon	mbers. d via these example to these methods: only one side of the equation
A-REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	 multiple rational quant equation Multiple rational quant denominators radicals of the form √a x is a variable radicals of the form √a constants and x is a variable 	tities on both sides of the ities with differing \overline{ax} where <i>a</i> is a constant and $\overline{ax+b}$ where <i>a</i> and <i>b</i> are ariable
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,	TM1d Stimulus: The stem will present an original solutions. Example Stem: Select Yes or No to of x is a solution to the given equation $\frac{3}{4} = \frac{2}{x+1}$	equation with one or two indicate whether each value on.

Solution	Yes	No
<i>x</i> = 3		
$x = \frac{5}{3}$		
$X = \frac{3}{5}$		

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

Response Type: Matching Tables

or no real).

Tools: None



Task Model 2	Prompt Features: Identify the statement that correctly applies to the
Response Type:	Stimulus Guidelines:
Multiple Choice.	• The student is presented with a student's step by step solution to a
single correct	 The student is presented with a student's step by step solution to a problem involving rational and/or radical equations.
response	 Item difficulty can be adjusted via these example methods, but are
	not limited to these methods:
DOK Lovel 2	 variable is present on only one side of the equation
DOK Level 2	 multiple rational quantities on both sides of the equation
	 Multiple rational quantities with differing denominators
A-REI.2	\circ radicals of the form \sqrt{ax} where a is a constant and x is a
Solve simple rational	
and radical equations	variable $\sqrt{\frac{1}{2}}$ where $\sqrt{\frac{1}{2}}$ where $\sqrt{\frac{1}{2}}$
in one variable, and	\circ radicals of the form $\sqrt{ax+b}$ where a and b are constants and
give examples	x is a variable
snowing now	
may arise	TM2
indy drise.	Stimulus: The student is presented with multiple statements about the
	solution of a rational and/or radical equation.
Evidence Required:	
2. The student	Example Stem 1: A student solved $1 + \sqrt{x-3} = 0$ in four steps, as shown.
solutions to radical or	
simple rational	Step 1: $\sqrt{x-3} = -1$
equations, and	Step 2: $(\sqrt{x-3})^2 = (-1)^2$
recognizes where	Step 3: $x - 3 = 1$
extraneous solution(s)	Step 4: $x = 4$
might arise during the	
solving of the	Which statement is an accurate interpretation of the student's work?
equation.	·
	A The correct solution is $r = 4$
Tools: None	B The student made an error in Step 1
	C The student made an error in Step 2
	∇ . The student made an error in Step 3.
	equation
	Rubric: (1 point) The student selects the correct statement (e.g., D).
	Response Type: Multiple Choice, single correct response



HS Mathematics Ite	m Specification C1 IH Assessment Consortium
Task Model 2	Example Stem 2: A student solved $\sqrt{x^2 - 5} - 2 = 0$ in five steps, as shown.
Response Type:	Step 1: $\sqrt{x^2 - 5} = 2$
Multiple Choice, single correct	Step 2: $(\sqrt{x^2 - 5})^2 = 2^2$
response	Step 3: $x^2 - 5 = 4$
	Step 4: $x^2 = 9$
DOK Level 2	Step 5: $x = 3, x = -3$
A-REI.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 solved the equation correctly. B. The student made an error in Step 2. C. Only $x = -3$ is a solution to the original equation. D. Only $x = 3$ is a solution to the original equation.
	Rubric: (1 point) The student selects the correct statement (e.g., A).
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. Tools: None	Response Type: Multiple Choice, single correct response



HS Mathematics Item Specification C1	ΤI
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Task Model 1	Prompt Features: The student is prompted to solve a one-	
	step linear equation.	
Response Type:		
Equation/Numeric	Stimulus Guidelines:	
	 x may be fractional or decimal. If decimal, the 	
DOK Level 1	precision of x values can only be taken out to the	
	tenths place (e.g., 1.3).	
A-REI.3	One-variable, linear equation with numeric	
Solve linear	coefficients.	
equations and	• Item difficulty can be varied by adjusting the number	
inequalities in one	of steps involved in solving equations, as well as the	
variable, including	use of parentheses.	
equations with	TM	
coefficients	IMIA	
letters	Stimulus: The student is presented with a one-variable,	
letters.	linear equation that can be solved in one step.	
Evidence Required:	Example Stem: Enter the value for x that makes the given	
1. The student	equation true.	
understands that the		
factored form of a	48 = x - 3	
quadratic expression		
reveals the zeroes of	Rubric:	
the function it	(1 point) The student enters the correct value for the	
defines.	variable x (e.g., 51).	
_		
Tools: None	Response Type: Equation/Numeric	



HS Mathematics Iten	n Specification C1 TI
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Task Model 1	Prompt Features: The student is prompted to solve a
	multi-step linear equation.
Response Type:	
Equation/Numeric	Stimulus Guidelines:
DOK Level 2	 x may be fractional or decimal. If decimal, the precision of x values can only be taken out to the tenths place (e.g., 1.3).
A-REI.3 Solve linear	 One-variable, linear equation with numeric coefficients.
equations and inequalities in one variable, including equations with	 Item difficulty can be varied by adjusting the number of steps involved in solving equations, as well as the use of parentheses.
coefficients	TM1b
represented by letters.	Stimulus: The student is presented with a one-variable, linear equation that can be solved in multiple steps.
Evidence Required: 1. The student understands that the	Example Stem: Enter the value for <i>x</i> that makes the given equation true.
factored form of a quadratic expression	20x - 5(6x + 4) = 4x - 6
reveals the zeroes of	Rubric:
the function it defines.	(1 point) The student enters the correct value for the variable x (e.g., -1).
Tools: None	Response Type: Equation/Numeric
	1



Task Model 2a-b	Prompt Features: The student is prompted to solve a one-step linear inequality.
Response Types: Equation/Numeric; Multiple Choice, single correct response DOK Level 1	 Stimulus Guidelines: Item difficulty can be varied by adjusting the number of steps involved in solving inequalities, as well as the use of parentheses. <i>x</i> may be fractional or decimal. If decimal, the precision of <i>x</i> values can only be taken out to the tenths place (e.g., 1.3).
A-REI.3 Solve linear equations and inequalities in one	TM2a Stimulus: The student is presented with a one-variable linear inequality that can be solved in one step.
variable, including equations with coefficients represented by	Example Stem: Solve the inequality for n . $45 \ge -15n$.
letters.	Rubric: (1 point) The student enters the correct solution to the inequality ($a_1 a_2 a_3 a_4$)
2. The student solves linear inequalities in	Response Type: Equation/Numeric
one variable with numeric coefficients. Tools: None	TM2b Stimulus: The student is presented with a one-variable, one-step linear inequality.
	Example Stem: Which inequality represents all possible solutions of $-3n < 12$?
	A. <i>n</i> < -36 B. <i>n</i> < -4 C. <i>n</i> > -36 D. <i>n</i> > -4
	Rubric: (1 point) The student selects the correct option (e.g., D).
	Response Type: Multiple Choice, single correct response



HS Mathematics Item Specification C1	ΤI
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Task Model 2c	Prompt Features: The student is pro	mpted to so	lve a
	multi-step linear inequality.		
Response Types:			
Equation/Numeric;	Stimulus Guidelines:		
Matching Tables	 Item difficulty can be varied by of steps involved in solving ineq use of parentheses. 	adjusting th ualities, as	e number well as the
DOK Level 2	 x may be fractional or decimal. precision of x values can only be 	If decimal, t e taken out	the to the
A-REI.3 Solve linear	tenths place (e.g., 1.3).		
equations and inequalities in one	Stimulus: The student is presented w multi-step linear inequality.	ith a one-va	ariable,
equations with	TM2c		
represented by	Example Stem: Solve the inequality f	or <i>w</i> .	
letters.	-2w + 17 < 13.		
Evidence Required: 2. The student solves linear inequalities in one variable with	Rubric: (1 point) The student enters the correct inequality (e.g., $w > 2$).	ct solution t	o the
numeric coefficients.	Response Type: Equation/Numeric		
Tools: None	TM2d Example Stem: Evaluate the claim as each set of numbers.	True or Fa	lse for
	Claim: All members of the set are solu given inequality.	tions for w	in the
	$20w - 5(6w + 4) \ge 4w - 6$		
	Decide if all members of each set are s False.	solutions. C	ick True or
		True	False
	{all negative real numbers}		
	{-1, 0, 1, 2}		
	{all positive real numbers}		
	$\{-3, -2, -1\}$		
	{-1}		
	Rubric:		
	(1 point) The student correctly matche	s true or fa	lse to each
	option (e.g., FFFTT).		
	Response Type: Matching Tables		



Task Model 3	Prompt Features: The student is asked to solve a one-step linear equation to identify appropriate value(s) of a letter
Response Type: Equation/Numeric	coefficient given specific information about a variable.
	Stimulus Guidelines:
DOK Level 1	 x may be fractional or decimal. If decimal, the precision of x values can only be taken out to the
A-REI.3	tenths place (e.g., 1.3).
Solve linear	 One-variable linear equation with some coefficients
equations and	represented as letters
	There difficulty can be varied by adjusting the number
inequalities in one	• Item difficulty can be varied by adjusting the number
variable, including	of steps involved in solving equations, as well as the
equations with	use of parentheses.
coefficients	
represented by	TM3a
lottors	Stimulue: The student is presented with a linear equation
letters.	Stimulus: The student is presented with a linear equation
	solvable in one step.
Evidence Required:	
3. The student solves	Example Stem 1: For the given equation, enter the value of
linear inequalities in	B when $x = 10$.
one variable with	
	Dv 20
letter coefficients or	Bx = 20
identifies appropriate	
value(s) of a letter	
coefficient given	Example Stem 2: For the given equation, enter the value of
specific information	B when $r - \frac{1}{2}$
about a variable in a	b when $x = \frac{1}{4}$.
	Bx = 20
inequality.	
Tools: None	Example Stom 2. For the given equation, enter the value of
	Example Stem 5: For the given equation, enter the value of
	B when $x = -5$.
	B
	$\frac{1}{r} = 20$
	Deckerier
	Rudric:
	(1 point) The student enters the correct value for B (e.g., 2;
	80; -100).
	Response Type: Equation/Numeric



HS Mathematics Item Specification C1	ΤI
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Task Model 3	Prompt Features: The student is asked to solve a one-step
	linear equation in one variable with letter coefficients.
Response Type:	
Equation/Numeric	Stimulus Guidelines:
DOK Level 1	 x may be fractional or decimal. If decimal, the precision of x values can only be taken out to the tenths place (e.g., 1.3).
A-REI.3	 One-variable linear equation with some coefficients
equations and	 Item difficulty can be varied by adjusting the number
inequalities in one variable, including equations with	of steps involved in solving equations, as well as the use of parentheses.
coefficients	тмзь
represented by letters.	Stimulus: The student is presented with a linear equation requiring one step to solve.
Evidence Required: 3. The student solves linear inequalities in one variable with	Example Stem: Solve the given equation for <i>x</i> . $\frac{x}{B} = 20$
letter coefficients or	
value(s) of a letter	Rubric:
coefficient given specific information	(1 point) The student enters the correct equation (e.g., $x = 20B$).
linear equation or inequality.	Response Type: Equation/Numeric
Tools: None	



Task Model 3	Prompt Features: The student is asked to solve a multi-
	step linear equation in one variable with letter coefficients.
Response Type:	
Equation/Numeric	Stimulus Guidelines:
	• x may be fractional or decimal. If decimal, the
DOK Level 2	precision of x values can only be taken out to the tenths place (e.g., 1.3).
A-REI.3	 One-variable linear equation with some coefficients
Solve linear	represented as letters.
equations and	 Item difficulty can be varied by adjusting the number
inequalities in one	of steps involved in solving equations, as well as the
variable, including	use of parentheses.
equations with	
coefficients	IM3C
represented by	Stimulus: The student is presented with a linear equation
letters.	requiring at least two steps to solve.
Evidence Required: 3. The student solves	Example Stem: Solve the given equation for <i>x</i> .
linear inequalities in	6x + Cx = 11
one variable with	
letter coefficients or	
identifies appropriate	Rubric:
value(s) of a letter	(1 point) The student enters the correct equation (e.g.,
coefficient given	$x = \frac{11}{6+C}$).
specific information	
about a variable in a	Response Type: Equation/Numeric
inear equation of	
Tools: None	



Task Model 3	Prompt Features: The student is asked to solve a multi-
	step linear equation to identify appropriate value(s) of a
Response Type:	letter coefficient given specific information about a variable.
Equation/Numeric	
	Stimulus Guidelines:
DOK Level 2	 x may be fractional or decimal. If decimal, the precision of x values can only be taken out to the
A-REI.3	tenths place (e.g., 1.3).
Solve linear	One-variable linear equation with some coefficients
equations and	represented as letters.
inequalities in one	• Item difficulty can be varied by adjusting the number
variable, including	of steps involved in solving equations, as well as the
equations with	use of parentheses.
coefficients	
represented by	TM3d
letters.	Stimulus: The student is presented with a linear equation
	requiring a minimum of two steps to solve.
Evidence Required:	
3. The student solves	Example Stem 1: For the given equation, enter the value
linear inequalities in	of B when $x = \frac{1}{5}$.
one variable with	5
letter coefficients or	$\frac{x}{2} = 20$
identifies appropriate	В
value(s) of a letter	
coefficient given	Example Stem 2: For the given equation, enter the value
specific information	of C when $F = 77$
about a variable in a	
inear equation or	$F = \frac{9}{2}C \pm 32$
inequality.	$1 - \frac{1}{5} - $
Tools: None	
IOOIS. None	Dubric
	(1 point) The student enters the correct solution (e.g.
	$1/100 \text{ or } 0.01 \cdot 25)$
	Response Type: Equation/Numeric



Task Model 4	Prompt Features: The student is prompted to solve a
	quadratic equation of the form $ax^2 = b$ by taking the square
Response Type:	root, resulting in two real solutions.
Equation/Numeric	
-	Stimulus Guidelines:
DOK Level 2	 Item difficulty can be adjusted via these example
	methods, but are not limited to these methods:
A-RFT_4	• The quadratic equation used can:
Solve quadratic	 have rational roots
equations in one	■ irrational roots
variable	
variable:	\sim The form of the quadratic equation can be
Evidence Required	• standard form $ar^2 + hr + c = 0$
A The student solves	- Standard form, $ax + bx + c = 0$. • vertex form $f(x) = a(x - h)^2 + k$
4. The student solves	• Other non-standard form such as:
in one variable by	- Other Holl-Standard form such as: $ hw = a - av^2 = a + av^2 - bv = av^2 $
taking square roots	$\pm bx \pm c = \pm ux, \pm c \pm ux = \pm bx, \pm ux \pm bx = \pm bx, \pm bx = bx$
completing the	$bx = \pm c (e.g., 5(x - 5) + 7 = 0, 0)$
completing the	$6x - 23 = -3x^2$).
square, using the	TMA
quadratic formula, or	IM4a Ctimulus The student is successed with a sucdustic
by factoring.	Stimulus: The student is presented with a quadratic
	equation in one variable equivalent to $ax^2 = b$ (with a and b
6. The student enters	as nonzero integers).
complex solutions for	
the quadratic formula	Example Stem: Solve the following equation for <i>n</i> .
in the form $a \pm bi$	
where <i>a</i> and <i>b</i> are	$18n^2 - 50 = 0$
real numbers.	
	Enter one solution in the first box. If there are two
Tools: None	solutions, enter the second solution in the second box.
	Rubric:
	(1 point) The student correctly enters the solution(s) to the
	equation (e.g., $x = -\frac{5}{3}$ and $x = +\frac{5}{3}$).
	Response Type: Equation/Numeric (two response boxes)



Task Model 4	Prompt Features: The student is prompted to solve a
	quadratic equation of the form $ax^2 = b$ by taking the square
Response Type:	root, resulting in two unique complex solutions.
Equation/Numeric	
	Stimulus Guidelines:
DOK Level 2	 Item difficulty can be adjusted via these example
	methods, but are not limited to these methods:
A-REI.4	\circ The quadratic equation used can:
Solve quadratic	 have rational roots
equations in one	 irrational roots
variable.	 complex roots
	 The form of the quadratic equation can be
Evidence Required:	• standard form, $ax^2 + bx + c = 0$.
4. The student solves	• vertex form, $f(x) = a(x-h)^2 + k$,
quadratic equations	 Other non-standard form such as:
in one variable by	$\pm bx \pm c = \pm ax^2, \pm c \pm ax^2 = \pm bx, \pm ax^2 \pm$
taking square roots,	$bx = \pm c$ (e.g., $5(x - 3)^2 + 7 = 0$, or
completing the	$6x - 23 = -3x^2$).
square, using the	TM4h
by factoring	Stimuluce The student is presented with a guadratic
by factoring.	equation in one variable equivalent to $ar^2 - b$ (with a and b)
6 The student enters	equation in one variable equivalent to $u_x = b$ (with a and b as nonzero integers)
complex solutions for	
the quadratic formula	Example Stem: Solve the following equation for <i>n</i>
in the form $a + hi$	
where a and b are	$18n^2 + 50 = 0$
real numbers.	
	Enter one solution in the first box. If there are two
Tools: None	solutions, enter the second solution in the second box.
	Rubric:
	(1 point) The student correctly enters the solution(s) to the
	equation (e.g., $x = -\frac{5}{3}i$ and $x = +\frac{5}{3}i$).
	Bechance Type, Equation/Numeric (two response hower)
	Response Type: Equation/Numeric (two response boxes)



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Task Model 4	Prompt Features: The student is prompted to solve a
	quadratic equation of the form $ax^2 + bx + c = 0$ by completing
Response Type:	the square.
Drag and Drop,	
Graphing	Stimulus Guidelines:
	• Item difficulty can be adjusted via these example
DOK LEVEI 2	methods, but are not limited to these methods:
	 The quadratic equation used can:
A-REI.4	 nave rational roots
Solve quadratic	
	 Complex roots The form of the guadratic equation can be
variable.	\circ The form of the quadratic equation can be
a) Use the method of	• Standard form $f(x) = g(x - h)^2 + h$
completing the	• Vertex form, $f(x) = u(x - h) + k$, • Other per standard form such as:
square to	• Other non-standard form such as: $bx + a = bax^2 + a + ax^2 = bbx + bax^2 + bbx + bax^2 + bbx $
	$\frac{1}{2}bx \pm c = \pm ax, \pm c \pm ax = \pm bx, \pm ax \pm bx = \pm c (a, a, 5(x-3)^2 \pm 7 = 0, a)$
	$bx = \frac{1}{2}c$ (e.g., $3(x - 3) + 7 = 0$, or $6x = 22 - 2x^2$)
	0x - 25 = -5x):
form $(x, y)^2 = q$	TM4c
that has the same	Stimulus: The student is presented with a quadratic
solutions Derive	equation in one variable equivalent to $ax^2 + bx + c = 0$ (with
the quadratic	a and b as nonzero integers).
formula from this	
form	Example Stem: Consider the equation: $x^2 - 14x + 45 = 0$
b) Solve quadratic	
equations by	Part A: Drag numbers into the boxes to rewrite the
inspection (e.g.,	equation in the form shown.
for $x^2 = 49$), taking	
square roots,	Part B: Use the Add Point tool to place a point for each
completing the	solution on the number line.
square, the	
quadratic formula	-94
and factoring, as	-14
appropriate to the	-7
initial form of the	-5 Part A
equation.	-4
the guadratic	$(x - \Box)^2 = \Box$
formula gives	4
complex solutions	5 Part B
and write them as	7
a + bi for real	14
numbers <i>a</i> and <i>b</i> .	
Evidence Required:	
4. The student solves	
quadratic equations	



in one variable by	Interaction: For the first part, the student will use drag
taking square roots,	and drop to rewrite the equation. For the second part, the
completing the	student plots points on a number line.
square, using the	
quadratic formula, or	Rubric:
by factoring.	(2 points) The student correctly rewrites the equation [1
	point] and correctly places both points on the number line
6. The student enters	[1 point] (e.g., 7; 4; points at 5 and 9).
complex solutions for	
the quadratic formula	Part A
in the form $a \pm bi$	
where <i>a</i> and <i>b</i> are	$(x - 7)^2 = 4$
real numbers.	
Tools: None	Part B
	<
	0 7 0 7 0
	Response Type: Drag and Drop, Graphing



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Task Model 4	Prompt Features: The student is prompted to setup and
	solve a quadratic equation using the quadratic formula.
Response Type:	China Casidalin a s
Drag and Drop,	Stimulus Guidelines:
Grapning	• Item difficulty can be adjusted via these example
	methods, but are not limited to these methods:
DOK Level 2	 The quadratic equation used can:
	 nave rational roots impliend roots
A-REI.4	
	 Complex roots The form of the supduptic equation can be
equations in one	• The form of the quadratic equation can be
variable.	• Standard form, $ax^2 + bx + c = 0$.
a) Use the method of	• Vertex form, $f(x) = a(x - n)^2 + k$, • Other per standard form such as:
completing the	• Other hon-standard form such as: $ h_{1} = a_{1} ^{2} a_{1} a_{2} ^{2} = h_{2} a_{2} ^{2}$
square to	$\pm Dx \pm c = \pm ax^{-}, \pm c \pm ax^{-} = \pm Dx, \pm ax^{-} \pm bx = \pm c + c + c + c + c + c + c + c + c + c$
	$bx = \pm c$ (e.g., $5(x - 5) \pm 7 = 0$, or $6x = 22 = -2x^2$)
	0x - 25 = -5x).
equation of the	TM4d
form $(x, y)^2 = a$	Stimulus: The student is given a guadratic equation in
that has the same	standard form: $ax^2 + bx + c = 0$ where a, b, and c are all one-
solutions Derive	digit numbers
the quadratic	
formula from this	Example Stem:
form	Part A: Drag and drop numbers from the list to enter an
b) Solve quadratic	equivalent equation for $3x^2 + 2x - 225 = 0$ into the quadratic
equations by	formula.
inspection (e.g.,	
for $x^2 = 49$),	Part B: Use the Add Point tool to place a point for each
taking square	solution on the number line
roots, completing	
the square, the	
quadratic formula	-225
and factoring, as	-6 Part A
appropriate to the	
initial form of the	$ -3 -(\Box) \pm \sqrt{(\Box)^2 - (\Box)(\Box)(\Box)}$
equation.	$-2 \qquad X = \frac{1}{(\Box)(\Box)}$
the guadratic	
complex solutions	
and write them as	
a + bi for real	
numbers a and b.	
Evidence Reauired:	
4. The student solves	
quadratic equations	



in one variable by	Interaction: For the first part, the student will use drag
taking square roots	and drop to enter a quadratic formula
taking square roots,	
completing the	
square, using the	Rubric:
quadratic formula, or	(2 points) The student produces the correct quadratic
by factoring.	formula and two correct values for <i>n</i> .
by raccomign	(1 point) The student produces the correct quadratic
	(1 point) The student produces the correct quadratic
6. The student enters	formula or two correct values for <i>n</i> .
complex solutions for	
the quadratic formula	Part A
in the form $a + bi$	
where a and b are	$(2) \pm \sqrt{(2)^2 (4)(2)(-225)}$
real numbers	$v = \frac{-(2) \pm v(2) - (4)(3)(-223)}{-(4)(3)(-223)}$
real numbers.	$^{-}$ (2)(3)
	(2)(3)
Tools: None	
	Part B
	-8 -4 U 4 8
	Response Type: Drag and Drop, Graphing



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HS Mathematics Iter	
Task Model 4	Prompt Features: The student is prompted to rewrite a
	non-standard quadratic equation into standard form to
Response Type:	identify a, b, and c values of the quadratic formula.
Drag and Drop	
	Stimulus Guidelines
DOK Loval 2	The difficulty can be adjusted via these example
DOK LEVEI Z	• Item uniculty can be aujusted via these example
A-REI.4	 The quadratic equation used can:
Solve quadratic	 have rational roots
equations in one	 irrational roots
variable.	 complex roots
a) Use the method of	 The form of the quadratic equation can be
completing the	• standard form, $ax^2 + bx + c = 0$.
square to	• vertex form $f(x) = a(x-h)^2 + k$.
transform any	 Other non-standard form such as:
quadratic	$\pm hr \pm c = \pm ar^2 \pm c \pm ar^2 = \pm hr \pm ar^2 \pm ar^2$
quadratic	$\frac{1}{2}bx - \frac{1}{2}c - \frac{1}{2}ux , \frac{1}{2}c - \frac{1}{2}bx, \frac{1}{2}ux - \frac{1}{2}bx, \frac{1}{$
equation in x into	$bx = \pm t (e.g., 5(x - 5) + 7 - 0, 0)$
an equation of the	$6x - 23 = -3x^2$).
form $(x-p)^2 = q$	
that has the same	TM4e
solutions. Derive	Stimulus: The student is given a quadratic equation in non-
the quadratic	standard (e.g., $5(x-3)^2 + 7 = 0$, or $6x - 23 = -3x^2$) where a,
formula from this	b, and c are all one-digit numbers
form.	
b) Solve quadratic	Example Stem: Drag and drop numbers from the list to
equations by	enter an equivalent equation for $2(x + 1)^2 = -3$ into the
inspection (e.g.,	quadratic formula.
for $x^2 = 49$),	
taking square	
roots, completing	
the square the	
quadratic formula	
and factoring as	
and factoring, as	
appropriate to the	
Initial form of the	-1 (D) $+ \sqrt{(-)^2 (-)(-)(-)}$
equation.	$ \begin{array}{c} 0 \\ 1 \end{array} \\ x = \frac{-() + v () - () () () () () }{- () () () () } \end{array} $
Recognize when	1 1 1 1 1 1 1 1 1 1
the quadratic	
formula gives	
complex solutions	
and write them as	
$a \pm bi$ for real	6
numbers <i>a</i> and <i>b</i> .	
Evidence Required:	
4. The student solves	
quadratic equations	Interaction : The student will select and place the correct
in one variable by	anadratic formula for the quadratic given
	ן קטמטרמנוכ וסודווטומ וסר נווב קטמטרמנוכ פועפוו.



taking square roots, completing the square, using the quadratic formula, or by factoring.	Rubric: (1 point) The student produces the correct quadratic formula (e.g., $x = \frac{-(4)\pm\sqrt{(4)^2-(4)(2)(5)}}{(2)(2)}$).
6. The student enters complex solutions for the quadratic formula in the form $a \pm bi$ where <i>a</i> and <i>b</i> are real numbers. Tools: None	Response Type: Drag and Drop



	IS Mathematics Iten	
	Task Model 4	Prompt Features: The student is prompted to setup and
		solve a quadratic equation using the quadratic formula.
	Response Type:	Chiman Luc Cuidelines
	Drag and Drop	Stimulus Guidelines:
	DOK Level 2	• The quadratic equation used call.
	DOR LEVEL 2	• Item difficulty can be adjusted via these example
	A-REI.4	methods, but are not limited to these methods:
	Solve quadratic	• The form of the guadratic equation can be
	equations in one	• standard form, $ax^2 + bx + c = 0$.
	variable.	• vertex form, $f(x) = a(x-h)^2 + k$,
	a) Use the method of	 Other non-standard form such as:
	completing the	$\pm bx \pm c = \pm ax^2, \pm c \pm ax^2 = \pm bx, \ \pm ax^2 \pm$
	square to	$bx = \pm c$ (e.g., $5(x-3)^2 + 7 = 0$, or
	transform any	$6x-23=-3x^2$).
	quadratic	
	equation in x into	IM4t Chimmeless The student is necessary durith a supplication
	an equation of the	Stimulus: The student is presented with a quadratic equation in one variable equivalent to $ar^2 + br + c = 0$ with
	form $(x-p)^2 = q$	equation in one variable equivalent to $ax^2 + bx + c = 0$ with $a_1b_2 + b_2 + c = 0$ with
	colutions Dorivo	
	the quadratic	Example Stem: Use the drop down menu to enter an
	formula from this	equivalent equation for $n^2 - 3n = 10$ by factoring, and the
	form.	solutions for n (n_1 and n_2).
	b) Solve quadratic	
	equations by	$(\square n \square)(\square n \square) = 0$
	inspection (e.g.,	
	for $x^2 = 49$),	
	taking square	
	roots, completing	
	the square, the	
	and factoring as	
	ann accornig, as	
	initial form of the	
	equation.	
	Recognize when	$n_1 = $ $n_2 = $
	the quadratic	
	formula gives	
	complex solutions	
	and write them as	
	$a \pm bi$ for real	
	numbers a and b.	
	Evidence Required	
	4. The student solves	9 9
ļ	quadratic equations	
	in one variable by	Interaction: The student will use the drop down menu in







Task Model 5	Prompt Features: The student is prompted to identify the
	quadratic equation that has no real solutions.
Response Type:	
Multiple Choice,	Stimulus Guidelines:
single correct	• All quadratic equations for this task model must have
response	complex solutions.
DOK Level 2	 Item difficulty can be adjusted via these example methods, but are not limited to these methods: Students are asked to identify a
A-REI.4	quadratic equation with complex
Solve quadratic	solutions, multiple choice.
equations in one	\circ The form of the quadratic equation can be:
variable.	• standard form, $ax^2 + bx + c = 0$
	• vertex form, $f(x) = a(x-h)^2 +$
Evidence Required:	k (e.g., $5(x-3)^2 + 10 = 0$).
5. The student	• other non-standard forms such as: $\pm bx \pm$
recognizes when the	$c = \pm ax^2$, $\pm c \pm ax^2 = \pm bx$ or $\pm ax^2 \pm bx =$
quadratic formula	$\pm c$ (e.g., $6x - 23 = 3x^2$).
enters complex	TM5a
solutions.	Stimulus: The student is presented with multiple quadratic
	equations in one variable equivalent to $ax^2 + bx + c = 0$ with
6. The student enters	a, b, and c as nonzero integers.
complex solutions for	
in the form $a \pm bi$	Example Stem: Which equation has no real solutions?
where a and b are	A. $4x^2 + 4x - 24 = 0$
real numbers.	B. $x^2 + 4x + 16 = 0$
Toola Nana	C. $5x^2 + 3x - 1 = 0$
TOOIS: None	D. $3x^2 - 4x + 1 = 0$
Development Note:	Rubric:
No more than 5% of this target should	(1 point) The student selects the correct option (e.g., B).
come from this task model TM5a.	Response Type: Multiple Choice, single correct response


Task Model 5	Prompt Features: The student is prompted to solve a		
	quadratic equation using the quadratic formula which		
Response Type:	results in complex solutions.		
Multiple Choice,			
single correct	Stimulus Guidelines:		
response	• All quadratic equations for this task model must have		
-	complex solutions.		
DOK Level 2	• Item difficulty can be adjusted via these example		
	methods, but are not limited to these methods:		
A-REI.4	 Students are asked to identify a 		
Solve quadratic	quadratic equation with complex		
equations in one	solutions multiple choice		
variable	\sim The form of the quadratic equation can be:		
variable.	standard form $ar^2 + hr + c = 0$		
	- Standard form, $dx + bx + c = 0$		
Evidence Required:	$= \frac{1}{k} \left(\frac{1}{k} - \frac{1}{k} \right)^2 + \frac{1}{k} \left(\frac{1}{k} - \frac{1}{$		
5. The student	κ (e.g., $J(x - 3) + 10 - 0$).		
recognizes when the	• Other hon-standard forms such as. $\pm bx \pm$		
quadratic formula	$c = \pm ax^2, \pm c \pm ax^2 = \pm bx \text{ or } \pm ax^2 \pm bx =$		
enters complex	$\pm c$ (e.g., $6x - 23 = 3x^2$).		
solutions.	ТМБЬ		
	Stimulus: The student is given a guadratic equation with		
6. The student enters	complex roots in standard form : $ax^2 + bx + c = 0$		
complex solutions for			
the quadratic formula	Example Stomy What are the colutions for the given		
in the form $a \pm bi$	equation?		
where <i>a</i> and <i>b</i> are			
real numbers.	$x^{2} + 4x + 16 = 0$		
	$x^{-} + 4x + 10 = 0$		
Tools: None			
	A. $x = -2 \pm 4i\sqrt{3}$		
	B. $x = -2 \pm 2\sqrt{3}$		
	C. $x = -2 \pm 2i\sqrt{3}$		
	D. $x = -2 \pm 4\sqrt{3}$		
	Rubric:		
	(1 point) The student selects the correct option (e.g., C).		
	Response Type: Multiple Choice, single correct response		
1			



Task Model 1	Prompt Features: The student is prompted to determine a solution point to the graph of an equation.
Response Type: Multiple Choice, single correct response DOK Level 1	 Stimulus Guidelines: Graphs are on a maximum 20 by 20 grid with scaled a labeled axes. Real number solutions only. Item difficulty can be adjusted by: varying the order of the equation using integer or real numbers in the solution s
A-REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).	 TM1a Stimulus: The stem will present a Cartesian graph and ask to student to select an ordered pair that is a solution to the equation represented by the graph. Example Stem 1: Select the ordered pair that is most likely solution to the equation represented by the graph.
Evidence Required: 1. The student understands that the graph of an equation in two variables is the set	

of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Tools: Calculator

- and
 - et



A. (0, 3) B. (0, 4.5) C. (2.5, 0) D. (4.5, 0)

Rubric: (1 point) The student selects the correct ordered pair (e.g., B).

Response Type: Multiple Choice, single correct response



Task Model 1

Response Type: Multiple Choice, single correct response

DOK Level 1

A-REI.10

Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Evidence Required:

1. The student understands that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Tools: Calculator





Task Model 1

Response Type: Multiple Choice, single correct response

DOK Level 2

A-REI.10

Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Evidence Required:

1. The student understands that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Tools: Calculator

Prompt Features: The student is prompted to determine the correct statement about the solution set of the given graph.

Stimulus Guidelines:

- Graphs are on a maximum 20 by 20 grid with scaled and labeled axes.
- Real number solutions only.
- Item difficulty can be adjusted by:
 - varying the order of the equation
 - o using integers or real numbers in solution set

TM1b

Stimulus: The student is presented with a graph of a function and its equation.

Example Stem: This graph represents the equation $y = 0.5^{(x-5)}$.



How many solutions are there for the equation in the interval 1 < x < 9?

- A. There are no solutions to the equation in the interval 1 < x < 9.
- B. There are exactly 2 solutions to the equation in the interval 1 < x < 9.
- C. There are exactly 7 solutions to the equation in the interval 1 < x < 9.
- D. There are an infinite number of solutions to the equation in the interval 1 < x < 9.

Rubric: (1 point) Student selects the correct statement about the solution set (e.g., D).

Response Type: Multiple Choice, single correct response



Task Model 1

Response Type: Hot Spot

DOK Level 2

A-REI.10

Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Evidence Required:

1. The student understands that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Tools: Calculator

Prompt Features: The student is prompted to determine the consecutive integer interval(s) that contain(s) the *x*- or *y*- coordinates(s) of a point(s) on the graph of a polynomial function.

Stimulus Guidelines:

- Graphs are on a maximum 20 by 20 grid with scaled and labeled axes.
- Real number solutions only.
 - Item difficulty can be adjusted by:
 - \circ $\;$ the order of the given polynomial function
 - \circ $% \left({{{\rm{b}}}{\rm{b}}} \right)$ the number of intervals the student is required to select

TM1c

Stimulus: The student is presented with a graph of a polynomial, the type of function, and an ordered pair with unknown *x*- or *y*-coordinate.

Example Stem 1: The graph of a quadratic function y = f(x) is shown.



The points (*b*, 13) and (*c*, 13) are both on the graph of this function and $b \neq c$.

- Select the consecutive integer interval on the number line that contains the value of *b*.
- Select the consecutive integer interval on the number line that contains the value of *c*.

-5-4-3-2-1 0 1 2 3 4 5



Task Model 1

Response Type: Hot Spot

DOK Level 2

A-REI.10

Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Evidence Required:

1. The student understands that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).



Interaction: The student selects the correct consecutive integer interval(s) on the number line.

Rubric: (1 point) Student chooses only the correct consecutive integer intervals:



V

8 6

4

2

-8 - 6 -

Example Stem 2: The graph of a cubic function y = f(x) is shown.

14

6 8

2

Х



Prompt Features: The student is prompted to determine the *x*-Task Model 2 coordinate of the solution point to the graph of two functions. **Response Type: Equation/Numeric** • DOK Level 1 A-REI.11 Explain why the x-TM2a coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); y = g(x). find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or q(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. **Evidence Required:** 2. The student finds solutions (either exact or approximate as appropriate) to the equation f(x) = g(x)using technology to araph the functions,

Stimulus Guidelines:

- Graphs are on a maximum 20 by 20 grid with scaled and labeled axes.
- Real number solutions only.
- Item difficulty can be adjusted by varying the order of the functions graphed.

Stimulus: The student is presented with a graph in the coordinate plane of two intersecting functions. Functions may or may not be identified.

Example Stem: This graph shows linear equations y = f(x) and



Rubric: (1 point) The student correctly enters the xcoordinate(s) of the point(s) where the graph of the two functions intersect (e.g., -4).

Tools: Calculator

approximations.

make tables of values, or find their successive





Response Type:	
Multiple Choice,	
multiple correct	

DOK Level 1

Task Model 2

A-REI.11

response

Explain why the xcoordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

Evidence Required:

2. The student finds solutions (either exact or approximate as appropriate) to the equation f(x) = g(x)using technology to graph the functions, make tables of values, or find their successive approximations. **Prompt Features:** The student is prompted to select the solution(s) to the equation f(x) - g(x) = 0.

Stimulus Guidelines:

- Graphs are on a maximum 20 by 20 grid with scaled and labeled axes.
- Real solutions only.
- Item difficulty can be adjusted by varying the order of the functions graphed.

TM2b

Example Stimulus: The stem will present a Cartesian graph of two functions and ask for the student to select the x-coordinate of the point(s) of intersection of the two graphs.

Example Stem 2: This graph shows equations $f(x) = 4.5\sqrt{x}$ and $g(x) = \left(\frac{1}{2}\right)x^2$.



Select **all** answer choices that best represent solutions to the equation f(x) - g(x) = 0.

A. x = 0 B. x = 5.0 C. x = 11.7 D. x = 13.5 E. x = 20.0

Tools: Calculator

Rubric: (1 point) The student correctly enters the *x*-coordinates of the points where the graph of the two functions intersect (e.g., A, C).

Response Type: Multiple Choice, multiple correct response



Task Model 2

Response Type: Multiple Choice, single correct response

DOK Level 1

A-REI.11

Explain why the xcoordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

Evidence Required:

2. The student finds solutions (either exact or approximate as appropriate) to the equation f(x) = g(x)using technology to graph the functions, make tables of values, or find their successive approximations.

Tools: None

Prompt Features: Identify the graph of f(x) and g(x) and the solutions given the equation f(x) = g(x).

Stimulus Guidelines:

- Graphs are on a maximum 20 by 20 grid with scaled and labeled axes.
- Real number solutions only.
- Item difficulty can be adjusted by varying the order of the functions graphed.

TM2c

Stimulus: The student is presented with two functions in equation form.

Example Stem: Select the graph with the correct solutions for f(x) = g(x) when $f(x) = x^2 - 1$ and g(x) = x + 1.



Rubric: (1 point) The student selects the correct graph of f(x) and g(x) and the solutions to the equation f(x) = g(x) (e.g., B).

Response Type: Multiple Choice, single correct response



Posponso Typo

Task Model 2

Prompt Feature: Identify approximate solutions for f(x) = g(x) from the graph of the equations y = f(x) and y = g(x).

Response Type: Multiple Choice, multiple correct response

DOK Level 1

A-REI.11

Explain why the xcoordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

Evidence Required:

2. The student finds solutions (either exact or approximate as appropriate) to the equation f(x) = g(x)using technology to graph the functions, make tables of values, or find their successive approximations. from the graph of the equations y = f(x) and y = g(x). Stimulus Guidelines:

- Graphs are on a maximum 20 by 20 grid with scaled and labeled axes.
- Real number solutions only.
- Item difficulty can be adjusted by varying the order of the functions graphed.

TM2d

Stimulus: The student is presented with the graphs of f(x) and g(x) where the solutions are not integers.

Example Stem: The graph shows a cubic function, f(x), and an exponential function, g(x). Select **all** values that are approximate solutions to the equation f(x) = g(x).



A. x = -1.5B. x = -1.1C. x = 0D. x = 0.5E. x = 3.6

Rubric: (1 point) Student selects the values that are approximate solutions (e.g., A, D, E).

Tools: Calculator

Response Type: Multiple Choice, multiple correct response



Task Model 2

Response Type: Drag and Drop

DOK Level 1

A-REI.11

Explain why the xcoordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x);find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

Evidence Required:

2. The student finds solutions (either exact or approximate as appropriate) to the equation f(x) = g(x)using technology to graph the functions, make tables of values, or find their successive approximations.

Tools: Calculator

Prompt Features: Given the function graphs for f(x) and g(x) student is prompted to drag and drop specific points to correct locations on their graph.

Stimulus Guidelines:

- Graphs are on a maximum 20 by 20 grid with scaled and labeled axes.
- Real number solutions only.
- Item difficulty can be adjusted by:
 - varying the order of the functions graphed
 - the number of points of intersection of f(x) and g(x)

TM2e

Stimulus: The student is presented with a graph in the coordinate plane of two intersecting functions. Functions may or may not be identified.

Example Stem: The graphs of y = f(x) and y = g(x) are shown. Drag three points to the coordinate grid to show a possible location described.



A) Show the location of a point with coordinates that are a solution to y = f(x) only.

B) Show the location of a point with coordinates that are a solution to y = g(x) only.

C) Show the location of a point with an *x*-coordinate that is a solution to f(x) = g(x)







Response Type: Multiple Choice, single correct response

DOK Level 1

A-REI.12

Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding halfplanes.

Evidence Required:

3. The student graphs the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality).

Tools: None

Prompt Features: Given a linear inequality in two variables student is prompted to select the corresponding graph.

Stimulus Guidelines:

- Graphs are on a maximum 20 by 20 grid with scaled and labeled axes.
- Real number solutions only.
- Item difficulty can be adjusted by:
 - varying the level of algebra necessary to obtain a form of the given inequality that can be graphed
 - using integer, rational, or real variable coefficients or constants

TM3a:

Stimulus: The student is presented with a linear inequality in two variables.

Example Stem: Select the graph that shows the solution set of the linear inequality, $y > -\frac{2}{3}x + 5$.



Response Type: Multiple Choice, single correct response



Task Model 3

Response Type: Equation/Numeric

DOK Level 2

A-REI.12

Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding halfplanes.

Evidence Required:

3. The student graphs the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality).

Tools: None

Prompt Features: Given a linear inequality in two variables graphed on the Cartesian Plane student is prompted to enter the corresponding linear inequality.

Stimulus Guidelines: (same as TM3a)

TM3b:

Stimulus: The student is presented with a graph of the solution set of a linear inequality in two variables.

Example Stem: The graph shown represents the set of ordered pairs that are solutions to an inequality.



Enter the inequality that represents the solution set shown by the graph.

Rubric: (1 point) Student enters the inequality (e.g., $y \ge -x + 1$).

Response Type: Equation/Numeric



Task Model 3

Response Type: Graphing

DOK Level 2

A-REI.12

Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding halfplanes.

Evidence Required:

3. The student graphs the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality).

Tools: None

Prompt Features: Given a linear inequality in two variables student is prompted to graph it on the Cartesian plane and identify a point that is in the solution set of the given linear inequality.

Stimulus Guidelines:

- Graphs are on a maximum 20 by 20 grid with scaled and labeled axes.
- Real number solutions only.
- The linear inequality must use ≤ or ≥ and not be a strict inequality.
- Item difficulty can be adjusted by:
 - varying the level of algebra necessary to obtain a form of the given inequality that can be graphed
 - can be adjusted using integer, rational, or real variable coefficients or constants

TM3c:

Stimulus: The student is presented with one linear inequality in two variables.

Example Stem:

Part A:

Graph the line representing the boundary of the linear inequality, $x + y \ge 1$.

Part B:

Plot a point representing an ordered pair that is part of the solution set of this inequality.



Interaction: The student uses a graphing tool to draw a line representing the boundary of the inequality. Student then plots a point within the region that represents the solution set of the inequality.







Task Model 4

Response Type: Graphing

DOK Level 2

A-REI.12

Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding halfplanes.

Evidence Required:

4. The student will be able to graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding halfplanes.

Tools: None

Prompt Features: Given a system of linear inequalities in two variables student is prompted to graph them on the Cartesian Plane and plot a point that is in the solution set of the given system.

Stimulus Guidelines:

- Graphs are on a maximum 20 by 20 grid with scaled and labeled axes.
- Real number solutions only.
- The linear inequality must use ≤ or ≥ and not be a strict inequality.
- Item difficulty can be adjusted by:
 - varying the level of algebra necessary to obtain a form of the given inequality that can be graphed
 - using integer, rational, or real variable coefficients

TM4a:

Stimulus: The student is presented with a system of linear inequalities in two variables.

Example Stem:

Part A:

Graph the lines representing the boundaries of the system of linear inequalities.

 $3x + 2y \le 6$ $4x - y \le 8$

Part B:

Plot a point within the solution set.









Task Model 4

Response Type: Hot Spot

DOK Level 1

A-REI.12

Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding halfplanes.

Evidence Required:

4. The student will be able to graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding halfplanes.

Tools: None

Prompt Features: Given a system of linear inequalities in two variables student is prompted to click on their graph to highlight the region of the graph that represents the solution set of the given system of linear inequalities.

Stimulus Guidelines: (same as TM4a)

TM4b:

Example Stimulus: The student is presented with a system of linear inequalities in two variables.

Example Stem: Click on the region of the graph that contains the solution set of the system of linear inequalities.





Response Type: Hot Spot

Interaction: The student clicks on the correct region of the graph that contains the solution set to the system of linear inequalities.

Rubric: (1 point) Student correctly selects the region containing the solution set.





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Task Model 4
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Response Type: Multiple Choice, single correct response

DOK Level 1

A-REI.12

Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding halfplanes.

Evidence Required:

4. The student will be able to graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding halfplanes.

Tools: None

Prompt Features: Given a system of linear inequalities in two variables student is prompted to select the corresponding graph representing their solution set.

Stimulus Guidelines: (same as TM4a)

TM4c:

Stimulus: The student is presented with a system of linear inequalities in two variables.

Example Stem: Select the graph that shows the solution set of the system of linear inequalities.





Task Model 4Prompt Features: Given a system of linear inequalities in two variables student is prompted to graph the system and select points that are in the solution set of the system.Box Level 2TM44: Example Stimulus: The student is presented with a system of linear inequalities in two variables.A-REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequalities in two variables as the intersection of the corresponding half- planes.TM44: Example Stimulus: The student is presented with a system of linear inequalities.Part B: variables as the intersection of the corresponding half- planes.Part B: V V V Part ATools: NonePart B (-4, 4) (-4, 0) (0, 4) (0, -4) (4, 0)Part B: (-4, 4) (-4, 0) (0, 4) (0, -4) (4, 0)Interaction: The student graphs the boundary lines of alle to graph the solution set.Part B (-4, 4) (-4, 0) (0, 4) (0, -4) (4, 0)Interaction: The student graphs the boundary lines of a system of linear inequalities correctly and selects the ordered pairs in the solution set.Part B (-4, 4) (-4, 0) (0, 4) (0, -4) (4, 0)Interaction: The student graphs the boundary lines for a system of linear inequalities correctly and selects the ordered pairs in the solution set.Part B (-4, 1) (-4, 0) The student graphs the boundary lines for a system of linear inequalities correctly and selects the ordered pairs in the solution set.Cols: NonePart B (-4, 4) (-4, 0) select the ordered pairs in the select if each ordered pair is within the solution set.Part B (-4, 4) (-4, 0) (0, 4) (0, -4) (4, 0)			
Response Type: Graphing; Hot SpotStimulus Guidelines: (same as TM4a)DOK Level 2TM4d: Example Stimulus: The student is presented with a system of linear inequalities in two variables.A-REI.12 Graph the solutions to a linear inequality, and graph the solution set to a system of linear interection of the corresponding half- planes.TM4d: Example Stimulus: The student is presented with a system of linear inequalities.Evidence Required: 4. The student will be able to graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half- planes.VTools: NoneVVPart B $(-4, 4) (-4, 0) (0, 4) (0, -4) (4, 0)$ Interaction: The student uses a graphing tool to draw a line representing the boundary lines of each inequality. Student then selects if each ordered pair is within the solution set.Part B $(-4, 4) (-4, 0) (0, 4) (0, -4) (4, 0)$ Interaction: The student uses a graphing tool to draw a line representing the boundary line of each inequality. Student then selects if each ordered pair is within the solution set.Rubric: (2 points) The student graphs the boundary lines for a system of linear inequalities correctly on selects the ordered pairs in the solution set.	Task Model 4	Prompt Features: Given a system of linear inequalities in two variables student is prompted to graph the system and select points that are in the solution set of the system.	
Graphing; Hot SpotStimulus Guidelines: (same as TM4a)DOK Level 2TM4d: Example Stimulus: The student is presented with a system of linear inequalities in two variables.A-REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary inte case of a strict inequalities in two variables as the intersection of the corresponding half- planes.TM4d: Example Stem: Part A: Graph the lines representing the boundaries of the system of linear inequalities.Evidence Required: 4. The student will be able to graph the solution set to a system of linear inequalities in two vorraibles as the intersection of the corresponding half- planes.VTools: NoneVVPart B $(-4, 4) (-4, 0) (0, 4) (0, -4) (4, 0)$ Interaction: The student uses a graphing tool to draw a line representing the boundary lines for a system of linear inequalities correctly and selects the ordered pairs in the solution set.Part B $(-4, 4) (-4, 0) (0, 4) (0, -4) (4, 0)$ Interaction: The student uses a graphing tool to draw a line representing the boundary lines for a system of linear inequalities correctly and selects the ordered pairs in the solution set.Rubric: (2 points) The student graphs the boundary lines for a system of linear inequalities correctly or selects the ordered pairs in the solution set.	Response Type:	······································	
DOK Level 2ThisTools: NoneTools: NoneThisTools: Colspan="2">Tools: Colspan="2">Tools: Colspan="2">Tools: Colspan="2">Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Co	Graphing; Hot Spot	Stimulus Guidelines: (same as TM4a)	
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in the case of a strict inequality, and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half- planes. Tools: None $3x + 2y \le 6$ $4x - y \le 8$ $Part B:$ Determine if each ordered pair is a part of the solution set of the system of linear inequalities. Select the ordered pair(s) that are in the solution set. Part A V	(excluding the boundary	linear inequalities.	
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solution set.		linear inequalities correctly or selects the ordered pairs in the	
		solution set.	







Task Model 1	Prompt Features: Distinguish between functions and non-		
	functions based on recognizing that each element of the domain		
Response Type:	maps to exactly one element of the range.		
Multiple Choice,			
multiple correct	Stimulus Guidelines: The student is prompted to select which of		
response	a selection of graphs represent functions.		
	 Graphs throughout should be properly identified (e.g., 		
DOK Level 1	f(x) = y).		
	• Graph may be linear, quadratic, rational, or piece-wise		
F-IF.1	functions		
Understand that a	 Scale dimensions: v-min: -10, v-max: 10, v-min: -10, v- 		
function from one set	= 10		
(called the domain) to	There difficulty and here diverted here winds the true of		
another set (called the	Item difficulty can be adjusted by varying the type of		
range) assigns to each	functions and non-functions represented by the graphs.		
element of the domain	TM1a		
exactly one element of	IMIA Stimuluce The student is presented with six graphs, representing		
the range. If r is a	a variety of functions and non-functions		
function and x is an			
then f(x) denotes the	Example Stem 1: Select all graphs that are graphs of functions		
then $I(x)$ denotes the	Example Stem 1. Select an graphs that are graphs of functions.		
corresponding to the			
input v. The graph of f	<u>у</u>		
is the graph of the			
equation $v = f(x)$			
Evidence Required:			
1. The student			
understands that a			
function from one set			
(the domain) to			
another set (the range)			
assigns to each element			
of the domain exactly			
one element of the			
range (e.g., distinguish			
between functions and			
non-functions).			
Tools: Calculator			



Task Model 1

Response Type: Multiple Choice, multiple correct response

DOK Level 1

F-IF.1

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

Evidence Required:

1. The student understands that a function from one set (the domain) to another set (the range) assigns to each element of the domain exactly one element of the range (e.g., distinguish between functions and non-functions).

Tools: Calculator





Task Model 1

Response Type: Multiple Choice, multiple correct response

DOK Level 1

F-IF.1

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

Evidence Required:

1. The student understands that a function from one set (the domain) to another set (the range) assigns to each element of the domain exactly one element of the range (e.g., distinguish between functions and non-functions).

Tools: Calculator



Rubric: (1 point) The student correctly selects all graphs of functions (e.g., A, D).

Response Type: Multiple Choice, multiple correct response



Task Model 1	Prompt Features: Distinguish between functions and non- functions based on recognizing that each element of the domain			
Response Type:	maps to exactly one element of the range.			
Multiple Choice, multiple correct	Stimulus Guidelines. The student is prompted to select which of			
response	a selection of equations represent functions.			
	There should be no fewer than four and no more than six			
DOK Level 1	answer choices.			
F-IF.1	 Item difficulty can be adjusted by varying the complexity of the equations. 			
Understand that a				
function from one set	TM1b			
(called the domain) to another set (called the range) assigns to each element of the domain exactly one element of	Stimulus: The student is presented with equations representing a variety of functions and non-functions. Equations may be linear, quadratic, polynomials, or absolute value. Students may graph or perform algebraic manipulations to check.			
the range. If <i>f</i> is a function and <i>x</i> is an element of its domain	Example Stem: Select all equations that are equivalent to an equation that expresses <i>y</i> as a function of <i>x</i> .			
then $f(x)$ denotes the	A. $3x - 4y = -2$			
output of f	B. $x - y^4 = 0$			
corresponding to the input x. The graph of f	C. $x^2 - 3y = 0$			
is the graph of the equation $y = f(x)$.	D. $ x + y = 2$			
Evidence Required:	Rubric: (1 point) The student correctly selects all options that represent y as a function of x (e.g., A, C).			
understands that a function from one set	Response Type: Multiple Choice, multiple correct response			
(the domain) to				
another set (the range)				
of the domain exactly				
one element of the				
range (e.g., distinguish				
non-functions).				
Tools: Calculator				



Task Model 1	Prompt Features: Distinguish between functions and non- functions based on recognizing that each element of the domain
Response Type:	maps to exactly one element of the range.
Multiple Choice,	
multiple correct	Stimulus Guidelines: The student is prompted to select which
response	function
DOK Level 2	 There should be no fewer than four and no more than six answer choices.
F-IF.1 Understand that a function from one set	 Item difficulty can be adjusted by varying the information about the domain and range of the function.
(called the domain) to	TM1c
another set (called the range) assigns to each element of the domain	Stimulus: The student is presented with the domain and range of a function $f(x)$, as well as two given values of the function.
exactly one element of	Example Stem:
the range. If <i>f</i> is a function and <i>x</i> is an element of its domain	A function, $f(x)$, has domain $-10 \le x \le 20$ and range $-40 \le f(x) \le -10$.
then $f(x)$ denotes the output of f	f(1) = -13 f(-10) = -40
input x . The graph of f is the graph of the	Select each statement that must be false about $f(x)$.
equation $y = f(x)$.	A. $f(1) = 13$ B. $f(-9) = 88$
Evidence Required:	C. $f(5) = -40$
1. The student	D. $f(0) = 0$
understands that a	E. $f(-15) = -20$
(the domain) to another set (the range) assigns to each element	Rubric: (1 point) The student correctly selects all valid options based on the stem (e.g., A, B, D, E).
of the domain exactly	Response Type: Multiple Choice, multiple correct response
one element of the	Response Typer Hultiple enoice, multiple concer response
range (e.g., distinguish	
between functions and non-functions).	
Tools: Calculator	



Task Model 1 Prompt Features: Distinguish between functions and nonfunctions based on recognizing that each element of the domain maps to exactly one element of the range. **Response Type:** Matching Tables Stimulus Guidelines: the student is presented with several data **DOK Level 1** tables and prompted to select which might represent functions. The tables should contain no fewer than four and no more **F-IF.1** than six pairs of data values. Understand that a Item difficulty can be adjusted by varying the size of the • function from one set tables and the complexity of the data in the tables. (called the domain) to another set (called the TM1d range) assigns to each **Stimulus:** The student is presented with three or four data tables. element of the domain exactly one element of **Example Stem:** Some students are studying graphs of functions the range. If *f* is a y = f(x) and other equations. Each table contains some points on a function and x is an particular graph. Decide whether each set of points **might be** on element of its domain, the graph of a function or **cannot be** on the graph of a function. then f(x) denotes the output of f corresponding to the Yes input x. The graph of f These points is the graph of the might be equation y = f(x). A. 0 1 1 4 4 х **Evidence Required:** 0 3 4 3 0 y 1. The student understands that a function from one set В. 0 2 (the domain) to 1 3 4 х another set (the range) 0 1 0 1 0 y assigns to each element of the domain exactly C. one element of the range (e.g., distinguish -2 0 1 3 4 х between functions and 3 3 3 3 3 y non-functions). **Tools:** Calculator **Rubric:** (1 point) The student correctly identifies the true statement (e.g. NYY).

Response Type: Matching Tables

No

These points

cannot be



Task Model 2

Response Type: Matching Tables

DOK Level 2

F-IF.1

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and x is an element of its domain, then f(x) denotes the output of *f* corresponding to the input x. The graph of f is the graph of the equation y = f(x).

Evidence Required:

2. The student understands that if f is a function and x is an element of its domain, then f(x) denotes the output of fcorresponding to the input of x.

Tools: None

Prompt Features: Determine any necessary restriction that needs to be placed on the domain in order for an equation to represent a function.

Stimulus Guidelines:

- All numbers, variables, and operations should be changed to create an item. Follow any stated guidelines on allowable number ranges, etc.
- Difficulty level can be altered by varying the type of functions.

TM2

Stimulus: The student is presented with four equations that are solved for f(x) and directed to match the domain that would define the equation as a function.

Example Stem: Select the domain for which each function is defined.

Function	All real numbers	x ≠ 2	x ≤ 2	x ≥ 2
$f(x) = \sqrt{2 - x}$				
$f(x) = \sqrt[3]{(x+2)}$				
$f(x) = \frac{x^2}{x-2}$				
$f(x) = \frac{\sqrt{x-2}}{x^3}$				

Rubric: (1 point) The student correctly matches the domain to its equation.

Function	All real numbers	x ≠ 2	x ≤ 2	x ≥ 2
$f(x) = \sqrt{2 - x}$				
$f(x) = \sqrt[3]{(x+2)}$				
$f(x) = \frac{x^2}{x-2}$				
$f(x) = \frac{\sqrt{x-2}}{x^3}$				

Response Type: Matching Tables



Task Model 3	Prompt Features: The student understands that the graph of <i>f</i> is the graph of the equation $y = f(x)$.
Response Type: Graphing DOK Level 2	 Stimulus Guidelines: All function graphs and function values should be changed to create an item. Difficulty level can be altered by varying the type of
F-IF.1 Understand that a	functions graphed.
function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of	TM3 Stimulus: The student is presented with one or two functions and directed to use the "Add Point" tool to plot points that lie on those functions. If two functions are used, the item may be worth two points.
the range. If <i>f</i> is a function and <i>x</i> is an element of its domain.	Example Stem: The graphs of $y = g(x)$ and $y = f(x)$ are shown.
then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y = f(x)$.	 Use the "Add Point" tool to add a point that will satisfy each given condition. A point on the graph of g where x=0. A point on the graph of g where f(x) > g(x). A point on the graph of f where f(x) = 0.
Evidence Required: 3. The student understands that the graph of <i>f</i> is the graph of the equation $y =$ f(x).	y = g(x)
Tools: None	
	-5 - 4 - 3 - 2 - 1 0 1 2 3 4 5 y = f(x) - 2







Task Model 4	Prompt Features: The student recognizes that sequences are functions whose domain is a subset of the integers.		
Response Type: Multiple Choice, single correct response DOK Level 1	 Stimulus Guidelines: All sequences should be changed to create an item. The domain of each function should be {1, 2, 3, 4, 5}. Difficulty level can be altered by varying the complexity of the sequence. 		
F-IF.3 Recognize that sequences are functions, sometimes	TM4 Stimulus: The student is presented with five terms of a sequence.		
defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by	Example Stem: Consider a sequence whose first five terms are 6, 12, 24, 48, 96.		
	Select the function (with domain of all integers $n \ge 1$) that can be used to define and continue this sequence.		
f(0) = f(1) = 1, f(n+1) = $f(n) + f(n-1)$ for $n \ge 1$.	A. $f(n) = 6n$		
Evidence Required: 4. The student	B. $f(n) = 6(n-1)$ C. $f(n) = 6n^2$ D. $f(n) = 6(2)^{n-1}$		
recognizes that sequences are functions whose domain is a subset of the integers.	Rubric: (1 point) The student correctly identifies the equation of the function defined by the sequence (e.g., D).		
Tools: None	Response Type: Multiple Choice, single correct response		



Task Model 1 **Prompt Features:** The student is prompted to identify true statements regarding key features of a given graph or table **Response Type:** representing a function that models a relationship between two Matching Tables quantities. The statements will be in the context of the relationship being modeled. Key features include the following: **DOK Level 1** intercepts intervals where the function is increasing or decreasing, positive F-IF.4 or negative relative maximums and minimums For a function that models a symmetries relationship asymptotes or end behavior between two periodicity auantities, interpret key **Stimulus Guidelines:** features of graphs Graph or table represents a function that increases or decreases and tables in the same amount (additively or multiplicatively) over each terms of the interval of the same length (e.g., linear or exponential). quantities, and Item difficulty can be adjusted via these example methods, but sketch graphs is not limited to these methods: showing key The graph or table represents a constantly increasing or 0 decreasing function (e.g., linear or exponential). features given a verbal description The graph or table represents a function with either one 0 of the relationship. relative maximum or minimum (e.g., guadratic). • The graph or table represents a function with multiple Key features include: relative maximums or minimums. intercepts; intervals where TM1a the function is **Stimulus:** The student is given a graph or table representing a function that models the relationship between two quantities in a real increasing, decreasing, world situation familiar to 15- to 17-year-olds, e.g., temperature positive, or change over time, or population change over a period of time. negative; relative **Example Stem 1:** This graph shows the population of mice in a study, maximums and modeled as a function of time. The study begins on day 0. minimums; symmetries; end behavior; and **Mouse Population** periodicity. **Over** Time Ρ Evidence **Required:** 200 1. The student interprets kev features of a Population graph or a table representing a

100

0

100

Time (day)

t

200

function modeling

Tools: Calculator

a relationship between two quantities.



Task Model 1	_				_						
	Det	termine whethe	er ea	ach sta	teme	ent is	true a	ccord	ling	to the	graph
Kesponse Type:	Sel	lect True or Fal	se to	or each	stat	emei	nt.				
matching lables			c	tatom	ont					True	Fale
DOK Level 1		ha mauca nanu	sitel		door	oacin	a hoty	non		nue	Fais
DOK LEVEL I	יד יד	ne mouse popu	ialiC RA	m was	uecro	easin	y betw	een			
F-TF-4		bo least numbe	r of	mico d	uring	1 tho	study	Wac			
For a function that	1 1	30		mice u	unng	Jule	study	was			
models a		bo mouso popu	latic		at ite	aro	atact a	roup	d		
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juantities.		Inere are two intervals where the mouse									
nterpret kev			leas	siriy.							
features of graphs	D.,	hrice (1 point)	The	ctudo	at co	rract		sta th	o tr	un and	falco
and tables in	Ku	orprotations of	kov	footur		nect	ly Selec	215 U		ue anu	table
terms of the			кеу	reatur	-510	prese		y un	e yn		lanie
quantities, and	1,1	1, 1, 1).									
sketch graphs	Ev	ample Stem 7	• Th	ic tabl	n cho	wc +	ho rola	tionc	hin	hotwoo	n tha
showing kev	EX.	ample Stem 2	a II A ita	ns table	e Shu	dict	ne rela			tarting	noint
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include:		Distance	0	25	2	F	6 F	0	10	10 E	12
intercepts:		Starting	0	2.5	3	5	0.5	0	10	10.5	12
intervals where		Starting Doint (ft)									
the function is		Point (it)	0	E 2 E	60	00	01 E	00	60	E 2 E	0
increasing,		Height (IL)	0	52.5	00	80	04.5	80	00	52.5	0
decreasing,		torming whath		ach ata	tomo	nt ic	truco	~~~~~	lina	to the	Fable
positive, or	De	loct True or Fol		acii Sta	ctat		true a	CCOIC	ing	to the	lable.
negative; relative	Sei	lect frue of rai	sen	Ji each	Slai	eme	it.				
maximums and					ont	•				True	Fale
minimums;		ha haight of the	3		ent	fron				True	Fais
symmetries; end				n decre	aseu			.ance			
behavior; and						ng p					
periodicity.	11	ne neight of the	e bai	li was a	it its	grea	test wr	ien i	C		
, ,	W	as approximate	ery 6	.5 reet	awa	y tro	m the				
Evidence	St	arting point.									
Required:		he ball was on	the g	ground	exac	ctly o	ne tim	e.			
1. The student	_										
interprets key	Ru	ibric: (1 point)	Ihe	stude	nt co	rrect	ly selec	cts tr	ie tr	ue and	false
features of a	lint	erpretations of	key	featur	es re	prese	ented b	by the	e gr	aph or t	table
graph or a table											
	F,	T, F).									
representing a	F, ⁻	T, F).									
representing a function modeling	F, Re	T, F). sponse Type:	Mat	ching ⁻	Гable	s					
representing a function modeling a relationship	F, Re	T, F). sponse Type:	Mat	ching ⁻	Гаble	S					
representing a function modeling a relationship between two	F, [•]	T, F). sponse Type:	Mat	ching ⁻	Гаble	s					
representing a function modeling a relationship between two quantities	F, [•]	T, F). sponse Type:	Mat	ching ⁻	Table	es					
representing a function modeling a relationship between two quantities.	F, Re	T, F).	Mat	ching ⁻	Table	S					
representing a function modeling a relationship between two quantities.	F,	T, F).	Mat	ching ⁻	Гаble	es					

Tools: Calculator



Task Model 1 **Response Type:** Hot Spot **DOK Level 1** intervals where the function is increasing or decreasing, positive or negative **F-IF.4** relative maximums and minimums For a function that symmetries models a relationship periodicity between two auantities, interpret key features of graphs TM1b and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. seconds). Key features include: intercepts; 8 intervals where 7 Distance (m) the function is 6 increasing, 5 decreasing, 4 positive, or negative; relative 3 maximums and 2 minimums; 1 symmetries; end behavior; and 0 periodicity.

Evidence **Required:**

1. The student interprets kev features of a graph or a table representing a function modeling a relationship between two quantities.

Tools: Calculator

3	
	Prompt Features: The student is prompted to identify points on a
	given graph that correspond to key features of events within a
	contextual situation. The graph is the representation of a function
	modeling the contextual situation. Key features include the following:
	intercepts

asymptotes or end behavior

Stimulus Guidelines: (same as TM1a)

Stimulus: The student is given a graph representing a function that models the relationship between two quantities in a real world situation familiar to 15- to 17-year-olds, e.g., temperature change over time, or population change over a period of time.

Example Stem: A bird flies out of its nest. This graph represents the distance it flies from its nest (in meters) as a function of time (in

Bird's Flight



Drag the star to mark the point on the graph that represents the bird's greatest distance from its nest. Then drag the circle to mark the point that represents the bird's return to its nest.

Interaction:

The student drags the star and circle to the correct points on the graph.

Rubric: (1 point) The student correctly identifies the point representing the bird's farthest distance from the nest and the point where the bird returns [e.g., approximately (7, 5.2) and (8.7, 0)].

Response Type: Hot Spot



Task Model 2	Prompt Features: The student is prompted to sketch a graph (or					
Deemonoo Tumou	points on a graph) showing key features given a verbal					
Response Type:	description of a relationship between two quantities. Key features					
Grapning	include the following:					
DOK Level 2	 intervals where the function is increasing or decreasing, positive or negative relative maximums and minimums 					
For a function that	symmetries					
models a relationshin	 Symmetries asymptotes or end behavior 					
hetween two	asymptotes of end behavior periodicity					
quantities interpret						
key features of graphs	Stimulus Guidelines:					
and tables in terms of	Item difficulty can be adjusted via these example methods.					
the quantities, and	but is not limited to these methods:					
sketch graphs showing	 A linear relationship that includes 					
key features given a	 a rate and an intercept, or 					
verbal description of	 two intercepts. 					
the relationship. Key						
features include:	TM2					
intercepts; intervals	Stimulus: The student is presented with a contextual situation,					
where the function is	familiar to 15- to 17-year-olds, where a function can model a					
increasing, decreasing,	relationship between two quantities.					
positive, or negative;						
relative maximums and	Example Stem 1: Mary is 10 miles from her nome.					
minimums;	• She is returning nome, waiking at a constant speed of 2					
behavior: and	Hor distance from home can be medeled as a function of					
periodicity	• The distance from nome can be modeled as a function of					
periodicity.	time.					
Evidence Required:	Marv's Walk Home					
2. The student	$\hat{}$					
sketches graphs						
showing key features						
given a verbal	u 18+					
description of a						

showing key features given a verbal description of a relationship between two quantities that can be modeled with a function.

Tools: Calculator



Use the Add Point and Connect Line tools to graph Mary's distance from home as a function of time.
Rubric:



Task Model 2

Interaction: The student uses the Add Point tool to place points on the grid, and the Connect Line tool to connect the points.

(1 point) The student creates the graph correctly (see below).

Response Type: Graphing

DOK Level 2

F-IF.4

For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing kev features given a verbal description of the relationship. Key features include: intercepts: intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

Evidence Required:

2. The student sketches graphs showing key features given a verbal description of a relationship between two quantities that can be modeled with a function.

Tools: Calculator



Example Stem 2: A ball is on the ground. Jon kicks the ball into the air. Assume that the height of the ball can be modeled as a quadratic function with respect to time. It reaches a maximum height of 64 feet and lands on the ground 4 seconds later.

Height of Ball Over Time



Use the Add Point tool to plot the points on the grid that represent

- when John kicks the ball,
- the ball at its highest point, and
- when the ball lands on the ground.



Task Model 2

Interaction: The student uses the Add Point tool to place points on the grid.

Response Type: Graphing

Rubric:

(1 point) The student plots the points correctly (see below).

DOK Level 2

F-IF.4

For a function that models a relationship between two quantities, interpret kev features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

Evidence Required:

2. The student sketches graphs showing key features given a verbal description of a relationship between two quantities that can be modeled with a function.

Tools: Calculator



Example Stem 3: A company is building a playground and needs to buy sand. The cost of sand is a function of the amount of sand purchased.

- The first 5 cubic feet cost \$1.50 per cubic foot.
- An amount greater than 5 cubic feet and less than or equal to 10 cubic feet costs \$1.25 per cubic foot.
- An amount over 10 cubic feet costs \$1.00 per cubic foot.

Use the Add Point and Connect Line tools to create a graph to show the total cost of the sand (in dollars) as a function of the amount of sand purchased (in cubic feet).

Cost of Sand Purchase



Height of Ball Over Time

HS Mathematics Item Specification C1 TL Task Model 2 Interaction: The stude

Rubric:



Response Type: Graphing

Interaction: The student uses the Add Point tool and Connect Line tool to graph the linear segments of a piecewise function on the grid.

(1 point) The student creates the graph correctly.

DOK Level 2

F-IF.4

For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key* features include: *intercepts; intervals* where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

Evidence Required:

2. The student sketches graphs showing key features given a verbal description of a relationship between two quantities that can be modeled with a function.

Tools: Calculator





HS Mathematics Item Specification C1 TL Task Model 3 Prompt Features: The s



Response Type: Multiple Choice, single correct response

DOK Level 2

F-IF.5

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of personhours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.

Evidence Required:

3. The student relates the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

Tools: Calculator

Prompt Features: The student is prompted to identify the graph representing the domain of a function given a contextual situation.

Stimulus Guidelines:

- The graphs must represent linear, quadratic, and other polynomial functions defined by a context and apply appropriate labels and scales.
- Item difficulty can be adjusted via these example methods, but is not limited to these methods:
 - Representing a linear function
 - Representing a quadratic function
 - Representing an exponential function
 - Representing a trigonometric function

ТМЗа

Stimulus: The student is presented with four graphs of a function in the coordinate plane, with the graphs in various intervals of positive and negative *x*-values.

Example Stem: Select the graph that correctly represents the amount of money, y, Jack earns doing chores for x hours at \$2 an hour if he works for a maximum of 8 hours.











Rubric: (1 point) The student identifies the correct graph (e.g., D).

Response Type: Multiple Choice, single correct response

HS Mathematics Item Specification C1 TL Task Model 3 Prompt Features: The



Response Type: Multiple Choice, single correct response

DOK Level 2

F-IF.5

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.

Evidence Required:

3. The student relates the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

Tools: Calculator

Prompt Features: The student is prompted to select the correct statement describing the domain or range of a function modeling a contextual situation.

Stimulus Guidelines:

- Item difficulty can be adjusted via these example methods, but is not limited to these methods:
 - The domain is indicated by the maximum and minimum values of a given graph or data table.
 - The domain is not indicated by the maximum and minimum values of a given graph or data table.
 - The domain is indicated by a description of the function.
 - The domain is represented by a set of coordinate pairs that the student has to calculate the domain value.

тмзь

Stimulus: The student is presented with a contextual situation, and asked to identify the domain of the function modeled by the given situation.

Example Stem: Billy buys light bulbs in packs of 8 for \$20. The shipping cost is \$10 regardless of the number of packs bought. Billy has only \$120 to spend.

The cost per light bulb with respect to number of packs bought can be modeled by a function. Select the statement that correctly describes the domain of the function.

- A. The domain is the set of all real numbers greater than or equal to 1 and less than or equal to 6.
- B. The domain is the set of all real numbers greater than or equal to 0 and less than or equal to 5.
- C. The domain is the set of all integers greater than or equal to 1 and less than or equal to 6.
- D. The domain is the set of all integers greater than or equal to 0 and less than or equal to 5.

Rubric: (1 point) The student correctly selects the statement describing the domain or range of the function (e.g., D).

Response Types: Multiple Choice, single correct response

HS Mathematics Item Specification C1 TL Task Model 3 Prompt Features: The



Response Type: Multiple Choice, multiple correct response

DOK Level 2

F-IF.5

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.

Evidence Required:

3. The student relates the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

Tools: Calculator

Prompt Features: The student is prompted to select the correct statement describing the domain or range of a function modeling a contextual situation.

Stimulus Guidelines: (same as TM3b)

ТМЗс

Stimulus: The student is presented with a contextual situation, and asked to identify the domain of the function modeled by the given situation.

Example Stem 1: A farmer is selling watermelons. She has 43 watermelons and plans to sell them for \$3 each. The farmer's total sales, in dollars, is a function of the number of watermelons she sells.

Select **all** the statements that correctly describe the domain or range of this function.

- A. The domain is the set of all integers from 0 to 43.
- B. The domain is the set of all real numbers from 0 to 43.
- C. The range is the set of all integers between 0 and 129.
- D. The range is the set of all multiples of 3 from 0 to 129.
- E. The range is the set of all multiples of 43 from 43 to 129.

Example Stem 2: Sue hits a ball from a height of 4 feet. The height of the ball above the ground is a function of the horizontal distance the ball travels. Consider this graph of the function.



Select **all** values that are in the domain of the function as shown in the graph.

A. -5 feet B. 0 feet C. 60 feet D. 220 feet

Rubric: (1 point) The student correctly selects the values that are within the domain (e.g., A, D; B, C).

Response Types: Multiple Choice, multiple correct response

HS Mathematics Item Specification C1 TL Task Model 4 Prompt Features: The



Response Type: Multiple Choice, single correct response

DOK Level 2

F-IF.6

Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Evidence Required:

4. The student
calculates and
interprets the average
rate of change of a
function presented
symbolically or as a
table and estimates the
rate of change of a
function from a graph.

Tools: Calculator

Prompt Features: The student is prompted to calculate the average rate of change of a given function over the specified interval, in terms of a context.

Stimulus Guidelines:

- Item difficulty can be adjusted via these example methods, but is not limited to these methods:
 - \circ The function is presented as a table.
 - The function is presented symbolically as a linear equation.
 - The function is presented symbolically as a quadratic or exponential equation.

TM4a

Stimulus: The student is presented with a function in symbolic form, representing a context familiar to 15- to 17-year-olds.

Example Stem: Craig records the number of minutes, *m*, it takes him to mow *n* lawns in a table.

п	1	2	3	4	5	6
m(<i>n</i>)	33	64	89	109	124	139

Select the average amount of time per lawn it takes Craig to mow the first 4 lawns. Round to the nearest minute per lawn.

A. 25 minutes per lawnB. 27 minutes per lawnC. 33 minutes per lawnD. 74 minutes per lawn

Rubric: (1 point) The student identifies the correct value for the average rate of change (e.g., B).

Response Types: Multiple Choice, single correct response

. . -



HS Mathematics Iten	n Specification C1 IL Assessment Consortium		
Task Model 4	Prompt Features: The student is prompted to estimate the rate		
	of change of a function from a graph.		
Response Type:			
Equation/Numeric	Stimulus Guidelines:		
•	• Item difficulty can be adjusted via these example methods,		
DOK Level 2	but is not limited to these methods:		
	• Representing a relationship modeled by a linear		
F-IF.6	function		
Calculate and interpret	• Representing a relationship modeled by a quadratic		
the average rate of	function, an exponential function (growth/decay), or a		
change of a function	trigonometric function (periodic event)		
(presented symbolically	 Representing a relationship modeled by a function not 		
or as a table) over a	capable of being represented as a linear, guadratic.		
specified interval.	exponential, or trigonometric function.		
Estimate the rate of			
change from a graph.	TM4b		
	Stimulus: The student is presented with a contextual situation,		
Evidence Required:	and the graph of the function modeled by the situation.		
4. The student			
calculates and	Example Stem: The height of a plant (in centimeters) is modeled		
interprets the average	as a function of time (in days). Consider this graph of the		
rate of change of a	function.		
function presented			
symbolically or as a	Plant Height		
table and estimates the			
rate of change of a			
function from a graph.			
Tools: Calculator	[] 60 +		
	$\mathbf{\tilde{z}}^{20}$		
	° 20 40 60		
	Time (day)		
	Enter the average rate of change for the height of the plant		
	Enter the average rate of change for the height of the plant,		
	measureu as centimeters per day, between day 0 and day 20.		
	Rubric:		
	(1 point) The student correctly enters the rate of change given a		
	nossible range of answers (e.g. 1.2 ± 0.1)		
	Response Type: Equation/Numeric		

HS	Mathematics	Item	Specification	C1	ΤL
				_	



Task Model 4	Prompt Features: The student is prompted to calculate the
	average rate of change of a given function over the specified
Response Type:	interval, in terms of a context.
Equation/Numeric	
	Stimulus Guidelines:
DOK Level 2	 Item difficulty can be adjusted via these example methods,
	but is not limited to these methods:
F-IF.6	 The function is presented as a table.
Calculate and interpret	 The function is presented symbolically as a linear
the average rate of	equation.
change of a function	 The function is presented symbolically as a quadratic or
(presented symbolically	exponential equation.
or as a table) over a	
specified interval.	TM4c
Estimate the rate of	Stimulus: The student is presented with a nonlinear function in
change from a graph.	symbolic form.
Evidence Required:	Example Stem: During the first years of growth the height of a
Evidence Required: 4. The student	Example Stem: During the first years of growth the height of a tree can be modeled with the function
Evidence Required: 4. The student calculates and	Example Stem: During the first years of growth the height of a tree can be modeled with the function
Evidence Required: 4. The student calculates and interprets the average	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10,$
Evidence Required: 4. The student calculates and interprets the average rate of change of a	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10,$ where t is the time in years since being planted and t is the
Evidence Required: 4. The student calculates and interprets the average rate of change of a function presented	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10,$ where <i>t</i> is the time in years since being planted and <i>h</i> is the being trip inches
Evidence Required: 4. The student calculates and interprets the average rate of change of a function presented symbolically or as a table and estimates the	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10$, where <i>t</i> is the time in years since being planted and <i>h</i> is the height in inches.
Evidence Required: 4. The student calculates and interprets the average rate of change of a function presented symbolically or as a table and estimates the rate of change of a	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10,$ where <i>t</i> is the time in years since being planted and <i>h</i> is the height in inches.
Evidence Required: 4. The student calculates and interprets the average rate of change of a function presented symbolically or as a table and estimates the rate of change of a function from a graph	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10$, where <i>t</i> is the time in years since being planted and <i>h</i> is the height in inches. Enter the average rate of change, in inches per year, from year 1 to year 5
Evidence Required: 4. The student calculates and interprets the average rate of change of a function presented symbolically or as a table and estimates the rate of change of a function from a graph.	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10$, where <i>t</i> is the time in years since being planted and <i>h</i> is the height in inches. Enter the average rate of change, in inches per year, from year 1 to year 5.
Evidence Required: 4. The student calculates and interprets the average rate of change of a function presented symbolically or as a table and estimates the rate of change of a function from a graph. Tools: Calculator	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10$, where <i>t</i> is the time in years since being planted and <i>h</i> is the height in inches. Enter the average rate of change, in inches per year, from year 1 to year 5. Bubric:
Evidence Required: 4. The student calculates and interprets the average rate of change of a function presented symbolically or as a table and estimates the rate of change of a function from a graph. Tools: Calculator	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10$, where <i>t</i> is the time in years since being planted and <i>h</i> is the height in inches. Enter the average rate of change, in inches per year, from year 1 to year 5. Rubric: (1 point) The student enters the correct answer for the average
Evidence Required: 4. The student calculates and interprets the average rate of change of a function presented symbolically or as a table and estimates the rate of change of a function from a graph. Tools: Calculator	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10$, where <i>t</i> is the time in years since being planted and <i>h</i> is the height in inches. Enter the average rate of change, in inches per year, from year 1 to year 5. Rubric: (1 point) The student enters the correct answer for the average rate of change given the units (e.g., 6).
Evidence Required: 4. The student calculates and interprets the average rate of change of a function presented symbolically or as a table and estimates the rate of change of a function from a graph. Tools: Calculator	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10$, where <i>t</i> is the time in years since being planted and <i>h</i> is the height in inches. Enter the average rate of change, in inches per year, from year 1 to year 5. Rubric: (1 point) The student enters the correct answer for the average rate of change given the units (e.g., 6).
Evidence Required: 4. The student calculates and interprets the average rate of change of a function presented symbolically or as a table and estimates the rate of change of a function from a graph. Tools: Calculator	Example Stem: During the first years of growth the height of a tree can be modeled with the function $h = -t^2 + 12t + 10$, where <i>t</i> is the time in years since being planted and <i>h</i> is the height in inches. Enter the average rate of change, in inches per year, from year 1 to year 5. Rubric: (1 point) The student enters the correct answer for the average rate of change given the units (e.g., 6). Response Type: Equation/Numeric



Та	sk Model 1	Prompt Features: The student is prompted to graph a simple			
		function and show key features			
Posponso Typo					
Craphing		Chimulus Cuidelines			
Gr	apning	Stimulus Guidelines:			
_		Graphs in answer choices must be within a -20 to 20			
DC	DK Level 2	coordinate grid, unless otherwise specified.			
		 Functions must be chosen so that Key Features fit on the 			
F-3	[F.7	grid.			
Gr	aph functions	Key Features are values that can be interchangeable on a			
ex	pressed symbolically	per item basis, e.g., "Which of these is the x-intercept of			
an	d show key features of	the function?"			
the	araph by hand in	The Key Feature being tested must represent a whole			
sin	onle cases and using	number or a decimal to the tenths place: see Stimulus			
tor	shoology for more	quidelines within task models			
	mplicated cases	• Linear functions will:			
201	Craph linear and	Linear functions will.			
a.		$0 De \ III \ UI = I0 \ III \ UI = III \ X + D$			
	quadratic functions	\circ $0 \leq m \leq 10, 0 \leq x \leq 10, and 0 \leq b \leq 10$			
	and show intercepts,	• Key Features for linear include:			
	maxima, and minima.	o slope			
b.	Graph square root,	o <i>x</i> -intercept			
	cube root, and	 y-intercept 			
	piecewise-defined	 The quadratic function may take the following forms: 			
	functions, including	a) $f(x) = ax^2 + bx + c$			
	step functions and	b) $f(x) = a(x-h)^2 + k$			
	absolute value	C) $f(x) = (dx + e)(fx + q)$			
	functions.	Key Features for guadratic include:			
с.	Graph polynomial	\circ x- intercepts and/or y-intercepts			
0.	functions identifying	 increasing interval and/or decreasing interval 			
	zeros when suitable	 necessing interval and/or negative interval 			
	factorizations are	o positive interval and/or negative interval			
	acconzacions are	o relative maximums and/or relative minimums			
	available, and showing	o symmetries			
	end benavior.	o ena benavior			
e.	Graph exponential and	o zeros			
	logarithmic functions,	Square Roots functions will:			
	showing intercepts	• take the form $f(x) = a\sqrt{x-h} + k$			
	and end behavior, and	o a is 1 or -1			
	trigonometric	 h and k are single digit integers 			
	functions, showing	 h and k must be chosen so that there are x- and y- 			
	period, midline, and	intercepts (e.g. not a function like $f(x) = \sqrt{x-3} + 1$)			
	amplitude.	Cube Roots functions will:			
		a have the form $f(x) = a^3\sqrt{x-h} + k$			
Εv	idence Required:	a = a = 1			
1.	Students graph	0 and k are single digit integers			
	functions expressed	O II difu K die Single uigit integers			
	symbolically and show	Precewise functions will:			
	key features of the	• nave pieces that are linear, quadratic, square root, or			
	aranh	absolute value			
	graph	Absolute Value functions will:			
Та		• have the form $f(x) = a x - h + k$			
10		\circ <i>a</i> is rational			
		\circ h and k are single digit integers			
		• Key Features for square root, cube root, absolute value, and			
		piecewise include:			
		 x- intercepts and/or y-intercepts 			
		\circ increasing interval and/or decreasing interval			



Task Model 1	 positive interval and/or negative interval
	 relative maximums and/or relative minimums
Response Type:	o symmetries
Graphing	 end behavior
	o zeros
DOK Level 2	Polynomials will:
	\circ have one variable only
F-IF.7	\circ have a minimum of two terms and maximum of five
Graph functions	terms
expressed symbolically	 be factorable
and show key features of	• be given in the form of: $f(x) = ax^n + bx^{n-1} + \dots + cx + d$,
the graph, by hand in	such that a, b, c, d must be integers greater than -5 and
simple cases and using	less than 5, and $0 \le n \le 4$, (i.e. maximum degree of 4)
technology for more	Key Features for polynomials include:
complicated cases.	• x- and y-intercepts (some polynomials will have only
	one x-intercept, e.g. $f(x) = x^{3}-27$
a. Graph linear and	• zeroes (some polynomials will have only one zero, e.g.
quadratic functions	$f(x) = x^{3} - 27$
maxima and minima	 relative maximum and minimum values and behavior
h Grand square root	• Logarithmic functions:
cube root and	c must be in the form $f(x) = a\log(x \pm h) \pm k$ or $f(x) = a\log(x \pm h) \pm k$
piecewise-defined	aln(x + h) + k
functions, including	\circ base 10 for log, or base e for ln
step functions and	Exponential functions:
absolute value	o must be in the form $f(x) = b^{x-h} + k$
functions.	• where $1 < b < 100$, h and k are single digit integers.
c. Graph polynomial	 Key Features include:
functions, identifying	\circ x- and y-intercepts
zeros when suitable	\circ end behavior
factorizations are	 Functions must be chosen so that requested Key Features
available, and showing	exist; for example, some exponential functions do not cross
end behavior.	one of the axes, such as $f(x) = 3^{x-1} + 4$, and $f(x) = \log(x - 1)$
e. Graph exponential and	4) + 2.
logarithmic functions,	 Item difficulty can be adjusted via these example methods,
showing intercepts	but are not limited to these methods:
and end behavior, and	 Linear, quadratic, absolute value, square root, cube
trigonometric	root, polynomials, piecewise, logarithmic, exponential.
functions, showing	
period, midline, and	TM1a Clines The shudest is successful with a function and a
amplitude.	Stimulus: The student is presented with a function and a
Evidence Required	coordinate grid.
1 Students graph	E eronale Change de Cinere e linear fonction with a class of ² and
functions expressed	Example Stem 1: Given a linear function with a slope of $\frac{1}{3}$ and
symbolically and show	a y-intercept of 2:
key features of the	Using the Add Arrow tool, draw a line on the coordinate
graph.	grid to graph the function.
J F	 Place a point on the line representing the x-intercept of the function
Tools: None	the function.
	Example Steps 2: Cines the function 2 is 2
	Example Stem 2: Given the function $y = \frac{1}{3}x + 2$,
	Using the Add Arrow tool, draw a line on the coordinate
	grid to graph the function.







Task Model 1	Prompt Features: The student is prompted to graph a complicated function, using the calculator tool, and show key
Response Type: Graphing	features.
DOK Level 2	Stimulus Guidelines: (same as TM1a)
DOR Level 2	TM1b
F-IF.7	Stimulus: The student is presented with a function and a
Graph functions	coordinate grid.
expressed symbolically	
and show key features of	Example Stem 1: Given the function $y = -x^2 + x + 6$,
the graph, by hand in	 Place a point on the coordinate grid to show each x-
simple cases and using	intercept of the function.
technology for more	 Place a point on the coordinate grid to show the
complicated cases.	maximum value of the function.
a. Graph linear and	
quadratic functions	Example Stem 2: Given the function $y = \sqrt{x} + 4 - 1$,
maxima and minima	 Diace a point on the coordinate grid to show each y
h Granh square root	intercept of the function
cube root, and	 Place a point on the coordinate grid to show the v-
piecewise-defined	intercept of the function.
functions, including	
step functions and	
absolute value	Example Stem 3: Given the function $y = \sqrt[3]{x-1} + 2$,
functions.	 Place a point on the coordinate grid to show the x-
c. Graph polynomial	intercept of the function.
functions, identifying	 Place a point on the coordinate grid to show the y-
factorizations are	intercept of the function.
available and showing	
end behavior	Example Stom 4: Civen this piecewise-defined function:
e. Graph exponential and	Example Stem 4. Given this piecewise-defined function: (-2x+5) for $x < -1$
logarithmic functions,	$y = \begin{cases} 3x^2 + 4 & \text{for } -1 \le x \le 1 \end{cases}$
showing intercepts	$(-4x^2 + 11 \text{ for } x > 1)$
and end behavior, and	
trigonometric	Place four points on the coordinate grid to show the
functions, showing	values of y when $x = -2, -1, 0, and 2$.
period, midline, and	
amplitude.	Example Stem 5: Given the function $y = 4x^3 + 8x^2 - 21x$
Evidence Required:	• Place a point on the coordinate grid to show each x-
1. Students graph	intercept of the function.
functions expressed	 Place a point on the coordinate grid to show each
symbolically and show	relative maximum or minimum value of the function.
key features of the	
graph.	
	Example Stem 6: Given the function $y = 3^{x-1} - 2$,
Tools: Calculator	• Place a point on the coordinate grid to show each x-
	Intercept of the function.
	Prace a point on the coordinate grid to show each relative maximum or minimum value of the function









Task Model 2	Prompt Features: Students are prompted to rewrite a guadratic to reveal the key features of its graph.
Response Type: Equation/Numeric DOK Level 2 F-IF.8a Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function: a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.	Quadratic to revear the key features of its graph.Stimulus Guidelines: The student is presented with a quadratic function used in a context. The quadratic function is:• given in the form of $ax^2 + bx + c$,• or in factored form, which is $a(x - h)(x - k)$,• or in completed square form, which is $a(x - h)^2 + k$, where $h = -b/2a$ and $k = c - b^2/4a$ • a, b, and c may be are numbers with an absolute value less than 20.TM2a Stimulus: The student is presented with a quadratic function.Example Stem: Enter an equation for the line of symmetry for the function $f(x) = -8x^2 + 16x + 2$.Rubric: (1 point) The student enters the correct equation (e.g., $x = 1$).Response Type: Equation/Numeric
Evidence Required: 2. Students write a quadratic function defined by an expression in equivalent factored form and completing the square form to reveal zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.	
Tools: None	



Response Type: Equation/Numeric

DOK Level 2

F-IF.8a

Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function:

> a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

Evidence Required:

2. Students write a quadratic function defined by an expression in equivalent factored form and completing the square form to reveal zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. **Prompt Features:** The student is prompted to rewrite a quadratic to reveal the key features of its graph, in terms of a context: the zeros, the maximum/minimum value, various points in terms of the line of symmetry, or intervals where the function is increasing/decreasing. Context can include, but is not limited to, an object being hit/thrown, profit, maximum area, and cost.

Stimulus Guidelines: The student is presented with a quadratic function used in a context. The quadratic function is:

- given in the form of $ax^2 + bx + c$,
- or in factored form, which is a(x h)(x k),
- or in completed square form, which is $a(x h)^2 + k$, where h = -b/2a and $k = c b^2/4a$
- a, b, and c may be are numbers with an absolute value less than 20.

TM2b

Stimulus: The student is presented with a quadratic function used in a context.

Example Stem 1:

John launches a toy rocket into the air. The rocket's height (*d*) in feet with respect to time (*t*) in seconds, can be modeled by the quadratic function, $d = -16t^2 + 16t + 32$.

Enter the maximum height, in feet, of the rocket.

Example Stem 2:

John launches a toy rocket into the air. The rocket's height (*d*) in feet with respect to time (*t*) in seconds, can be modeled by the quadratic function, $d = -16t^2 + 16t + 32$.

Enter the number of seconds it took for the rocket to hit the ground after it was launched.

Rubric:

(1 point) The student enters the correct value (e.g., 36; 2).

Response Type: Equation/Numeric

Tools: None



Task Model 3

Response Type: Matching Tables

DOK Level 1

F-IF.8b

Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function:

b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions, such as y = $(1.02)^t$, $y = (0.97)^t$, y = $(1.01)^{12t}$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay.

Evidence Required:

3. Students write an exponential function defined by an expression in an equivalent form using the properties of exponents to reveal and explain different properties of the function and to classify them as representing exponential growth or decay.

Tools: None

Prompt Features: The student will use the properties of exponents to interpret expressions for exponential functions.

Stimulus Guidelines:

- Exponential functions will:
 - be given in the form of $f(x) = ab^{(x-h)} + k$
 - \circ *h* is a single digit integer
 - \circ k is an integer, maximum value of 19
 - *a* = 1 or -1
 - *b* is a rational number, maximum value of 9; can be a non-repeating decimal.
- Key Features are values that can be interchangeable on a per item basis, e.g., "Which of these is the growth rate of the exponential function?"
- Key Features include:
 - o end behavior
 - rates of growth or decay
- The Key Feature being tested must represent a whole number or a decimal to the tenths place: see Stimulus guidelines within task models.
- Item difficulty can be adjusted to these example methods, but are not limited to these methods:
 - Interpreting growth vs. decay
 - Rewriting exponentials

тмз

Stimulus: The student is presented with multiple functions.

Example Stem: Determine whether each function represents exponential growth or decay. Select the correct option for each function.

Function	Growth	Decay
$f(x) = (1/2)^x$		
$f(x) = (3/2)^{4x}$		
$f(x) = (7/8)^{4x}$		
$f(x) = (4/3)^{\frac{x}{12}}$		
$f(x) = 3(1/3)^{\frac{x}{12}}$		

Rubric:

(1 point) The student correctly sorts the exponential functions (e.g., Decay, Growth, Decay, Growth, Decay).

Response Type: Matching Tables



Response Type: Matching Tables

DOK Level 2

F-IF.9

Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

Evidence Required:

4. Students compare properties of two functions represented in different ways (e.g., as equations, tables, graphs, or written descriptions).

Tools: Calculator

Prompt Features: Students will identify the relationships, common properties, or key features shared between two functions represented in different ways.

Stimulus Guidelines:

- Functions include: linear, quadratic, square root, cube root, piecewise-defined, absolute value, polynomial, exponential, and logarithmic functions.
- Key Features are values that can be interchangeable on a per item basis, e.g., "Which of these two functions has the higher relative maximum?"
- Key Features include:
 - maximum and minimum values (for quadratic, piecewise-defined, absolute value, and polynomial functions)
 - end behavior (for square root and logarithmic functions: positive *x*-direction only)
 - x-intercepts and y-intercepts (for x-intercepts, not exponential; for y-intercepts, not logarithmic)
 - increasing and decreasing intervals
 - lines of symmetry
 - o zeros
- The Key Feature being tested must represent a whole number or a decimal to the tenths place: see Stimulus guidelines within task models.
- Item difficulty can be adjusted to these example methods, but are not limited to these methods:
 - Functions come in table, graph or written description form.

TM4a

Stimulus: The student is presented with two functions that must be represented in two different ways. Functions can be represented as a table of values, a graph, a function equation, or a written description.

Example Stem: The graph represents f(x) and the table shows some values of another quadratic function g(x).





Response Type: Matching Tables



Task Model 4

Response Type: Hot Spot

DOK Level 2

F-IF.9

Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

Evidence Required:

4. Students compare properties of two functions represented in different ways (e.g., as equations, tables, graphs, or written descriptions).

Tools: Calculator

Prompt Features: Students will select sections on a number line that represent an interval where two graphs have a shared key feature.

Stimulus Guidelines: (same as TM4a)

TM4b

Stimulus: The student is given two different functions (square root, cube root, piecewise-defined, or absolute value) and a number line representing the *x*-axis, and asked to indicate where the functions have a shared key feature.

Example Stem: In which interval(s) on the *x*-axis are the functions $f(x) = \frac{1}{2}|2x| + 2$ and $g(x) = -2x^2 + 12x - 16$ increasing? Click the interval(s) on the number line that represents where **both** functions are increasing.



Interaction: The student will click on intervals on the number line using Hot Spots.

Rubric:

(1 point) The student clicks on the correct intervals (e.g., [1, 3]).



Response Type: Hot Spot



Task Model 4

Response Type: Matching Tables

DOK Level 2

F-IF.9

Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

Evidence Required:

4. Students compare properties of two functions represented in different ways (e.g., as equations, tables, graphs, or written descriptions).

Tools: None

Prompt Features: Students will identify the relationships, common properties, or key features shared between two functions represented in different ways.

Stimulus Guidelines: (same as TM4a)

TM4c

Stimulus: The student is presented with the graph of a quadratic function and a table of equations that may or may not represent the function.

Example Stem: Determine whether each equation in the table represents the graph of the function shown? Select Yes or No for each equation.



Function	Yes	No
f(x) = (x - 3)(x - 9)		
f(x) = (x+3)(x-9)		
f(x) = (x+6)(x-9)		
$f(x) = (x - 3)^2 - 18$		
$f(x) = (x - 6)^2 - 9$		

Rubric:

(1 point) Student correctly selects the functions that could be represented by the given graph (e.g., YNNNY).

Response Type: Matching Tables







Т

	E	quation	Graph A	Graph B	Graph	С
	f($x) = x\sqrt{3}$				
	f($f(x) = 3\sqrt{x}$				
	f($(x) = \sqrt{3x}$				
ul ra xa	bric: point) T ph (e.g.	he studer ., Table A Stem 2: S	nt correctly n , Table C, Ta Select the ap	natches the ble B). propriate b	functions	with
Id	Tab	ole A	Tab	le B	Tabl	le C
ſ	x	<i>f</i> (<i>x</i>)	x	<i>f</i> (<i>x</i>)	x	f(x)
Ī	1	1.73	1	1.73	1	3.00
-	2	3.46	2	2.45	2	4.24
	4	6.92	4	3.46	4	6.00
	6	10.38	6	4.24	6	7.35
	8	13.84	8	4.90	8	8.49
L	Eq	uation	Table A	Table B	Table C	
	f(x)	$) = x\sqrt{3}$				
	f(x	$() = 3\sqrt{x}$				
	f(x)	$) = \sqrt{3x}$				
t ul 1 p ab	bric: point) T le (e.g.,	he studer Table A,	it correctly n Table C, Tal	natches the ble B).	functions	with



Task Model 1	Prompt Features: The student is prompted to enter a function			
	that describes a relationship between two quantities by			
Response Type:	determining an explicit function from context.			
Equation/Numeric				
	Stimulus Guidelines: The student is presented with a			
DOK Level 2	contextual situation that describes a relationship between two			
	quantities that can be modeled by a function.			
F-BF.1	 Functions can include linear, quadratic, or exponential. Difficulty level can be altered by yamping the type of 			
while a function that	• Difficulty level can be altered by varying the type of function and context			
between two quantities				
a Determine an explicit	TM1a			
	Stimulus: Student is presented with a contextual situation			
recursive process or	Sumulus. Student is presented with a contextual situation.			
steps for calculation	Example Stem 1 : Jane is making a rectangular garden. The			
from a context	length of the garden is 2 yards greater than its width w in			
Hom a context.	vards.			
Evidence Required:				
1. The student writes	Enter the function, $f(w)$, which describes the area, in square			
explicit or recursive	yards, of Maria's garden as a function of the width, w.			
functions to describe	, , , , ,			
relationships between				
two quantities from a	Example Stem 2: Barb traveled 300 miles during the first 5			
context.	hours of her trip. Barb then traveled at a constant speed of 50			
	miles per hour for the remainder of the trip.			
Tools: Calculator				
	Enter the function, $f(h)$, which describes the average speed			
	during the entire trip as a function of time, h, in hours, Barb			
	traveled after her first 300 miles.			
	Example Stem 2: A washing machine was purchased for #256			
	Example Stem 5: A washing machine was purchased for \$250.			
	It loses – of its value each year.			
	Enter the function, $f(t)$, which describes the value of the washing			
	machine, in dollars, as a function of time in years, t, after the			
	initial purchase.			
	Rubric: (1 point) Student correctly enters the function describing			
	the relationship between two quantities in the given contextual			
	situation (e.g. $f(w) = w(w + 2)$; $f(h) = \frac{300+50h}{2}$; $f(t) = $256(0.75)^{t}$)			
	5+h = 5+h			
	Response Type: Equation/Numeric			



Task Model 1	Prompt Features: The student is prompted to enter a function that describes a relationship between two quantities by				
Response Type: Equation/Numeric	determining a recursive process from context.				
	Stimulus Guidelines: The student is presented with a				
DOK Level 2	contextual situation that describes a relationship between two quantities that can be modeled by a function				
F-BF 1	Function types can include linear quadratic or				
Write a function that	• I unclion types can include linear, quadratic, of				
describes a relationship	exponential.				
	• Difficulty level call be altered by varying the type of				
between two quantities.	function and context.				
a. Determine an explicit					
expression, a	TM1b				
recursive process, or steps for calculation	Stimulus: The student is presented with a contextual situation.				
from a context.	Example Stem 1: A researcher studies the growth of a fruit fly				
	population. The researcher counts the number of fruit flies at				
Evidence Required:	noon each day. The results are in the table				
1 The student writes	noon each day. The results are in the table.				
1. The student writes					
explicit or recursive	Day Number of				
functions to describe	Fruit Flies				
relationships between	0 4				
two quantities from a	1 0				
context.					
	2 16				
Tools: Calculator	3 32				
	 V(t) = Total number of fruit flies after t days 				
	• $V(0) = 4$				
	v = v(0) = 1				
	Enter the function for $t > 1$ which describes the number of fruit				
	Effect the function for $t \ge 1$, which describes the number of fruit				
	mes, $V(t)$, at noon on the t^{-1} day in terms of the number of fruit				
	flies at noon on the previous day, $V(t-1)$.				
	Example Stem 2: The height of the water level in a tank is 200				
	inches. The water level increases at a constant rate of 3 inches				
	niches. The water level increases at a constant rate of 5 miches				
	every day.				
	II(t) = beight of the water level often t deve				
	• $H(t)$ = height of the water level after t days.				
	• $H(0) = 200$				
	Fatas the function for (> 4 that dependent the height of the surface				
	Enter the function for $t \ge 1$ that describes the height of the water				
	level, $H(t)$, on the t^{u} day in terms of the height of the water level				
	at the same time on the previous day, $H(t-1)$.				
	Rubric: (1 point) Student correctly enters the recursive function				
	describing the relationship between two quantities in the given				
	contextual situation [e.g., $V(t) = 2V(t - 1)$; $H(t) = H(t - 1) + 3$].				
	Response Type: Equation/Numeric				



Task Model 1	Prompt Features: The student is prompted to model a given contextual situation as a sequence using a recursive function or			
Response Type: Equation/Numeric	an explicit formula. The sequence position of data is known.			
	Stimulus Guidelines: The student is presented with a			
DOK Level 2	contextual description of two quantities.			
	The context can be modeled by:			
F-BF.1	 an arithmetic sequence 			
Write a function that	 a geometric sequence 			
describes a relationship	Difficulty level can be altered by varying the complexity of			
between two quantities.	function and context.			
a. Determine an explicit				
expression, a	TM1c			
recursive process, or steps for calculation	Stimulus: The student is presented with a contextual situation.			
from a context.	Example Stem 1: The first row in a theater has 8 seats, the			
	second row has 11 seats, the third row has 14 seats and the			
Evidence Required:	fourth row has 17 seats.			
1. The student writes	• $f(r)$ = the number of seats in row r .			
explicit or recursive	• $f(1) = 8$			
relationships between	Fature constinue for a construction describes the construction of			
two quantities from a	Enter an equation, for $r \ge 2$, which describes the number of			
context.	seats, $f(r)$, in the r^{th} row in terms of the number of seats in the $(r-1)^{th}$ row, $f(r-1)$. Assume that the pattern described applies			
Toola, Calculator	to all rows.			
	Example Stem 2: The 13 th row in a theater has 41 seats, the			
	12 th row has 38 seats, the 11 th row has 35 seats and the 10 th row			
	has 32 seats.			
	• $f(r)$ = the number of seats in row r.			
	• $f(1) = 5$			
	Enter an equation, for $r \ge 2$, which describes the number of			
	seats, $f(r)$, in the r^{th} row in terms of the number of seats in the			
	$(r-1)^{\text{th}}$ row, $f(r-1)$. Assume that the pattern described applies			
	to all rows.			
	Rubric: (1 point) Student correctly represents the sequence			
	using the recursive process [e.g., $f(r) = f(r-1) + 3$; $f(r) = f(r-1) + 3$].			
	Response Type: Equation/Numeric			



Task Model 2	Prompt Features: The student is prompted to select a recursive or explicit function that is equivalent to a given function.			
Response Type: Multiple Choice, single correct response	 Stimulus Guidelines: Sequences can be either arithmetic or geometric in a given item. Domain should only include integers, excluding rational 			
DOK Level 2 F-BF.2 Write arithmetic	 numbers. a₁ needs to be less than or equal to ±20. Difference between numbers in arithmetic sequence should be less than or equal to five. 			
and geometric sequences both recursively and with an explicit formula, use them to model	 Difficulty level can be altered by varying the type of function and context. 			
situations, and translate between the two forms.	Stimulus: The student is presented with an explicit or recursive function.			
Evidence Required: 2. The student translates	Example Stem 1: Consider this function in explicit form.			
between recursive functions and explicit functions.	$f(n) = 3n - 4; n \ge 1$ Select the equivalent recursive function.			
Tools: Calculator	A. $f(1) = -1$ $f(n) = f(n-1) + 3; n \ge 2$			
	B. $f(1) = -1$ $f(n) = 3f(n-1); n \ge 2$			
	C. $f(0) = -4$ $f(n) = 3f(n-1); n \ge 2$			
	D. $f(0) = -4$ $f(n) = f(n-1) + 3; n \ge 2$			
	Example Stem 2: Consider this function in recursive form.			
	f(1) = -3 $f(n) = 3f(n-1); n \ge 2$			
	Select the equivalent explicit function for $n \ge 1$.			
	A. $f(n) = -3(n)$ B. $f(n) = -3(n-1)$ C. $f(n) = -3(3)^n$ D. $f(n) = -3(3)^{(n-1)}$			
	Rubric: (1 Point) Student selects the correct choice (e.g., A; D).			
	Response Type: Multiple Choice, single correct response			



[
Task Model 2	Prompt Features: The student is prompted to match explicit functions with their equivalent recursive functions.				
Response Type: Matching tables DOK Level 2 F-BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the	 functions with their equivalent recursive functions. Stimulus Guidelines: All explicit functions will have an equivalent recursive function. Sequences can be either arithmetic or geometric in a given item. Domain should only include integers, excluding rational numbers. a₁ needs to be less than or equal to ±20. Difference between numbers in arithmetic sequence should be less than or equal to five. Difficulty level can be altered by varying the type and complexity of function. 				
two forms.	TM2b Stimulus: The student is presented with explicit and recursive functions				
Evidence Required: 2. The student translates between	Example Stem: Match each recursive function with the equivalent explicit function.				
recursive functions and explicit functions.	Functions	$f(n) = 3(10)^{(n-1)};$ $n \ge 1$	f(n) = 3n + 7; $n \ge 1$	$f(n) = 10(3)^{(n-1)};$ $n \ge 1$	
Tools: Calculator	f(1) = 10 f(n) = 3f(n - 1); $n \ge 2$				
	f(1) = 3				
	n(n) = 10n(n-1); $n \ge 2$				
	f(1) = 10				
	f(n) = f(n-1) + 3; $n \ge 2$				
	Click the appropriat the first column wit Interaction: The s in the first row and The student selects Rubric: (1 point) Student co	e box that match h its explicit func tudent is present three recursive f the cell in the ta prrectly matches	nes the recursi ction in the top ced with three functions in the able that match all functions.	ve function in row. explicit functions e first column. nes the functions.	



Functions		$\begin{array}{l} f(n)=3n+7;\\ n\geq 1 \end{array}$	$f(n) = 10(3)^{(n-1)};$ $n \ge 1$
f(1) = 10			
$\begin{array}{l} f(n)=3f(n-1);\\ n\geq 2 \end{array}$			
<i>f</i> (1) = 3			
f(n) = 10f(n - 1); $n \ge 2$			
$f(1) = 10f(n) = f(n - 1) + 3;n \ge 2$			
Response Type: M	atching tables		











Task Model 3	Prompt Features:	The student i	s prompted t	o model a given	
Decrance Type	contextual situation as a sequence using a recursive function.				
Response Type: Fill-in table	Stimulus Guidelin				
	• The student is presented with a contextual description of				
DOK Level 2	two quantities that can be modeled by:				
F-BF.1	o a geo	metric seque	nce		
Write a function that	The sequence position of data is known.				
describes a relationship between two quantities.	 Difficulty level can be altered by varying the type of function and context. 				
a. Determine an explicit					
expression, a recursive process, or	TM3bStimulus: The student is presented with a contextual situation.				
from a context	Evample Stem: A t	haatar naads	to place sea	ts in rows The	
	function. $f(r)$, as she	own below, ca	an be used to	determine the	
Evidence Required:	number of seats in e	each row, who	ere <i>r</i> is the ro	ow number.	
3. The student		-			
understands a function	f(1) = 8				
as a model of the	f(r) = f(r-1) + 3				
two quantities.	Use the function to	complete the	table indicati	ing the number of	
	seats in each of the	first four row	s of the thea	ter.	
Tools: Calculator				-	
		Row number	Number of Seats		
		Row 1			
		Row 2			
		Row 3			
		Row 4	 		
				1	
	Rubric: (1 point) St	udent correct	tly enters the	e sequence from the	
	recursive form into	the table.			
		Row	Number]	
		number	of Seats	-	
		Row 1	8	-	
		Row 2	11		
		Row 3	14		
		Row 4	17		
	Response Type: Fi	ll-in table			



Task Model 1	Prompt Features: The student is prompted to identify a trigonometric ratio (sine, cosine, or tangent) for the given angle.				
Response Type:					
Multiple Choice	Stimulus Guidelines:				
single correct	• Stimuli may include right triangles or descriptions of the features				
	(angles side lengths sine cosine or tangent values) of triangles				
Tesponse	 Right triangles have measures for sides or angles. 				
DOK Lovel 1	Right triangles may have unknown sides or angles that can be				
DOK Level 1	solved using trigonometric ratios.				
0 007 0	 Side lengths should be limited to less than 40. 				
G-SRI.6	 Side lengths may be whole numbers or simple expressions. 				
Understand that by	 Difficulty level can be altered by requiring basic definitions of the transmission of the transmission of transmissio				
right triangles are	trigonometric ratios or by applying the trigonometric ratios to find				
properties of the	lengths of sides of a right thangle, etc.				
angles in the triangle,	TM1a				
leading to definitions of	Stimulus: The student is presented with a right triangle that has given				
trigonometric ratios for	side lengths				
acute angles.					
Evidence Dequired					
1 Student uses the	Example Stem: Consider this right triangle.				
definitions of					
trigonomotric ratios for					
acute angles in a right					
trianglo	5				
thangle.					
Tools: Nono					
Ions. None	C A B				
	Select the ratio equivalent to $sin(B)$.				
	$(A) \frac{4}{\pi}$				
	B) $\frac{5}{3}$				
	C) $\frac{3}{5}$				
	D) $\frac{3}{2}$				
	Rubric: (1 Point) The student selects the correct ratio (e.g., C).				
	Response Type: Multiple Choice, sinale correct response				



Task Model 1	Prompt Features: The student is prompted to identify a trigonometric			
	ratio (sine, cosine, or tangent) for the given angle.			
Response Type:				
Matching Tables	Stimulus Guidelines:			
DOK Level 1	 Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles. Right triangles have measures for sides or angles. 			
G-SRT.6	 Right triangles may have unknown sides or angles that can be asked using triangles restrict ratios. 			
Understand that by similarity, side ratios in	 Side lengths should be limited to less than 40. Side lengths may be whole numbers or simple symposium. 			
right triangles are properties of the angles in the triangle, leading to definitions of	 Side lengths may be whole numbers or simple expressions. Difficulty level can be altered by requiring basic definitions of the trigonometric rations, or by applying the trigonometric ratios to find lengths of sides of a right triangle, etc. 			
trigonometric ratios for	TM1b			
acute angles.	Stimulus: The student is presented with a right triangle that has given			
Evidence Required:	side lengths.			
1 Student uses the				
definitions of	Example Stem: Consider this right triangle.			
trigonometric ratios for				
acute angles in a right	A			
triangle.	5			
Tools: None				

Determine whether each equation is correct. Select Yes or No for each equation.

	Yes	No
$\sin(A) = \frac{4}{5}$		
$\cos(A) = \frac{5}{3}$		
$\sin(B) = \frac{3}{5}$		
$\cos(B) = \frac{3}{4}$		

Rubric: (1 Point) The student chooses the correct option for each equation (e.g., YNYN).

Response Type: Matching Tables



Task Model 1	Prompt Features: The student is prompted to identify a trigonometric
	ratio (sine, cosine, or tangent) for the given angle.
Response Type:	
Equation/Numeric	Stimulus Guidelines:
DOK Level 1	 Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles. Right triangles have measures for sides or angles.
G-SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.	 Right triangles may have unknown sides or angles that can be solved using trigonometric ratios. Side lengths should be limited to less than 40. Side lengths may be whole numbers or simple expressions. Difficulty level can be altered by requiring basic definitions of the trigonometric ratios, or by applying the trigonometric ratios to find lengths of sides of a right triangle, etc. TM1c Stimulus: The student is presented with a right triangle that has given
Evidence Required:	side lengths.
1. Student uses the definitions of trigonometric ratios for acute angles in a right	Example Stem: Consider this right triangle.
triangle.	
Tools: None	3 C 4 B
	Enter the ratio equivalent to $sin(B)$.
	Rubric: (1 Point) The student enters the correct value (e.g., $\frac{3}{5}$).






Task Model 3	Prompt Features: The student is prompted to write the angle measure				
	that will satisfy an equation.				
Response Type:					
Equation/Numeric	Stimulus Guidelines:				
DOK Level 1	 Stimuli may include sine or cosine of a specified angle less than 90 degrees and its value. Sine or cosine of a missing angle with the same value as the 				
G-SRT.7 Explain and use the relationship between the sine and cosine of complementary	 given angle. Difficulty level can be altered by asking students to write the angle measure of complementary angles when comparing the sine and cosine value, compare the sine and cosine values of various angle measures, etc. 				
angles.	ТМЗ				
angreer	Stimulus: The student is given the value (as a fraction or a decimal) of				
Evidence Required: 3. Student explains and uses the relationship between	the sine or cosine for a specified angle and asked to fill in the blank for an equation involving the sine or cosine of the complement with the same value.				
the sine and cosine of complementary angles.	Example Stem 1: Let, $sin(47^\circ) = 0.7314$. Enter the angle measure (β), in degrees, for $cos(\beta) = 0.7314$.				
Tools: Calculator	Example Stem 2: Let, $sin(30^\circ) = \frac{1}{2}$. Enter the angle measure (β), in degrees, for $cos(\beta) = \frac{1}{2}$.				
	Rubric : (1 point) The student enters the correct angle that can be used to satisfy the equation.				
	Example Stem 1: any value so that $360n+43$ where <i>n</i> is an integers. Example Stem 2: any value so that $60(6n+1)$ where <i>n</i> is an integer.				
	Response Type: Equation/Numeric				



Task Model 4	Prompt Features: The student is prompted to identify true or false statements about two similar triangles. The lengths of two sides of one				
Response Type:	triangle and one side of the second triangle are labeled.				
Matching Tables					
	Stimulus Guidelines:				
Response Type: Matching Tables DOK Level 2 G-SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. Evidence Required: 4. Student uses the Pythagorean Theorem and trigonometric ratios to solve problems involving right triangles in mathematical or real- world context. Tools: Calculator	statements about two similar triangles. The lengths of two sides of one triangle and one side of the second triangle are labeled. Stimulus Guidelines: • Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles. • Right triangles may have unknown sides or angles that can be solved using trigonometric ratios. • Side lengths should be limited to less than 40. • Side lengths may he whole numbers or simple expressions. • Difficulty level can be altered by asking students to find the side or angle that can be found using a trigonometric expression, use knowledge of trigonometric ratios and Pythagorean Theorem to find a missing side length or angle measure in a right triangle, to solve for an angle measure or distance, given a verbal description of a situation where trigonometric ratios can be used, etc. TM4a Stimulus: The student is presented with two similar triangles. The lengths of two sides of one triangle and one side of the second triangle are labeled. Example Stem: Triangle ABC is similar to triangle WYZ. $A \int 26 \int 12 \int 12 \int 12 \int 12 \int 12 \int 12 \int 12$				
	Response Type: Matching Tables				



	•				
Task Model 4	Prompt Features: The student is prompted to determine trigonometric				
	functions that can be used to find a side length of a right triangle.				
Response Type:					
Matching Table	Stimulus Guidelines:				
Matching Table DOK Level 1 G-SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. Evidence Required: 4. Student uses the Pythagorean Theorem and trigonometric ratios to solve problems involving visible triangles in	 Stimulus Guidelines: Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles. Right triangles have measures for sides or angles. Right triangles may have unknown sides or angles that can be solved using trigonometric ratios. Side lengths should be limited to less than 40. Side lengths may be whole numbers or simple expressions. Difficulty level can be altered by asking students to find the side or angle that can be found using a trigonometric expression, use knowledge of trigonometric ratios and Pythagorean Theorem to find a missing side length or angle measure in a right triangle, to solve for an angle measure or distance, given a verbal description of a situation where trigonometric ratios can be used, etc. TM4b Stimulus: The student is presented with a right triangle and two side lengths or a side and an angle measure and asked to write the trigonometric equation used to solve for a side or angle. 				
right triangles in					
mathematical or real-	Example Stem: Consider this right triangle.				
world context.					
Tools: Calculator	A 5 C 12 B				
	Determine whether each expression can be used to find the length of <i>AC</i> .				
	Select Yes or No for each expression.				
	Yes No				
	13sin(<i>B</i>)				
	13cos(A)				
	12tan(A)				
	12tan(<i>B</i>)				
	Rubric: (1 point) The student selects the correct response for each expression (e.g., YYNY).				

Response Type: Matching Tables



Task Model 4	Prompt Features: The student is prompted to solve for a missing side in a right triangle using trigonometric ratios.					
Response Type:						
Fquation / Numeric	Stimulus Guidelines:					
DOK Level 2	 Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles. Right triangles have measures for sides or angles. 					
G-SRT.8 Use trigonometric ratios and the	 Right triangles may have unknown sides or angles that can be solved using trigonometric ratios. Side lengths should be limited to less than 40. Side lengths may be whole numbers or simple expressions. 					
to solve right triangles in applied problems.	 Difficulty level can be altered by asking students to find the s or angle that can be found using a trigonometric expression, knowledge of trigonometric ratios and Pythagorean Theorem find a missing side length or angle measure in a right triangle solve for an angle measure or distance, given a verbal description 					
Evidence Required: 4. Student uses the	of a situation where trigonometric ratios can be used, etc.					
Pythagorean Theorem	TM4c					
and trigonometric	Stimulus: The student is presented with a right triangle and asked to					
ratios to solve	Schluds. The student is presented with a right thangle and asked to					
problems involving	find a missing side using information given in the problem.					
	Example Stem: Consider this right triangle.					
right triangles in						
mathematical or real-						
world context.	A					
Tools: Calculator						
	15					
	$C \qquad B$					
	Enter the length of \overline{AC} , to the nearest tenth.					
	Rubric: (1 point) The student enters the correct side length (e.g., 13.5).					
	Response Type: Equation/Numeric					



Tack Model 4	Brompt Fostures: The student is prompted to solve for a missing angle				
Task Mouel 4	in a right triangle using trigonometric ratios.				
Response Type:					
Equation/Numeric	Stimulus Guidelines:				
DOK Level 2	 Stimuli may include right triangles or descriptions of the features (angles, side lengths, sine, cosine, or tangent values) of triangles. 				
G-SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. Evidence Required: 4. Student uses the	 Right triangles have measures for sides or angles. Right triangles may have unknown sides or angles that can be solved using trigonometric ratios. Side lengths should be limited to less than 40. Side lengths may be whole numbers or simple expressions. Difficulty level can be altered by asking students to find the side or angle that can be found using a trigonometric expression, use knowledge of trigonometric ratios and Pythagorean Theorem to find a missing side length or angle measure in a right triangle, to solve for an angle measure or distance, given a verbal description of a situation where trigonometric ratios can be used, etc. 				
and trigonometric ratios to solve problems involving	Stimulus: The student is presented with a right triangle and asked to find a missing angle using information given in the problem.				
right triangles in mathematical or real- world context.	Example Stem: Consider this right triangle.				
Tools: Calculator	C 12 B				
	Enter the measure of $\angle A$, to the nearest degree.				
	Rubric: (1 point) The student enters the correct angle measure (e.g., 53).				
	Response Type: Equation/Numeric				



Task Model 4	Prompt Features: The student is prompted to identify the equation for a missing angle in a right triangle given real-world context by using the					
Response Type:	Pythagorean Theorem and trigonometric ratios.					
Multiple Choice,						
multiple correct	Stimulus Guidelines:					
response	 Two of the side lengths are known. 					
-	• The student may be given information about the triangle in the					
DOK Level 1	preamble and/or a picture.					
DOR LEVEL I	It must be a right triangle.					
C CRT 0	Difficulty level can be altered by giving students a verbal					
G-SKI.8	description and a picture, or by giving them a verbal description					
Use trigonometric	only, etc.					
ratios and the						
Pythagorean Theorem	TM4e					
to solve right triangles	Stimulus: The student is presented with a right triangle in a real-world					
in applied problems.	context.					
Evidence Required:	Example Stem: Bob uses a 20 foot ladder to paint a section of his					
4 Student uses the	house that is 16 feet high					
Bythagorean Theorem	house that is to reet high.					
and trigonomotric	\wedge					
ratios to solve						
problems involving						
right triangles in						
mathematical or real-						
world context.	$ \qquad $					
	16 ft 20 ft					
Tools: Calculator						
	$x \rightarrow Ground$					
	Select all equations that can be used to solve for Θ .					
	$\Lambda \sin \theta = \frac{12}{2}$					
	$-\frac{12}{20}$					
	B. $\cos\theta = \frac{1}{20}$					
	C. $\tan \theta = \frac{12}{20}$					
	D. $\sin\theta = \frac{16}{20}$					
	E. $\cos\theta = \frac{16}{20}$					
	F. $\tan \theta = \frac{16}{20}$					
	20					
	Rubric: (1 point) The student is able to identify all correct equations					
	(e.g., B,D).					
	Response Type: Multiple Choice, multiple correct response					

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Task Model 4 **Prompt Features:** The student is asked to find a missing side length or angle measure of a right triangle that can be used to model a real-world **Response Type:** situation. Examples of right triangles in context include but are not **Equation/Numeric** limited to: survey problems, height of an object, navigation, ramps, shadows, etc. **DOK Level 2 Stimulus Guidelines:** G-SRT.8 Two of the side lengths are known. The student may be given information about the triangle in the Use trigonometric preamble and/or a picture. ratios and the It must be a right triangle. Pythagorean Theorem Difficulty level can be altered by giving students a verbal to solve right triangles description and a picture, or by giving them a verbal description in applied problems. only, etc. **Evidence Required:** TM4f 4. Student uses the **Stimulus:** The student is provided with information in context to be able Pythagorean Theorem to create a situation in which a right triangle can be created to help solve and trigonometric a problem in context. A picture may/may not be provided. ratios to solve problems involving **Example Stem:** Donna wants to calculate the height of a tree. She right triangles in makes the following measurements. mathematical or real-The length of the tree's shadow is 29 meters. world context. The angle of elevation from the ground to the top of the tree is 30°. Tools: Calculator Iree 30° Ground 29 m Enter the height of the tree, in meters. Round your answer to the nearest whole meter. **Rubric:** (1 point) The student finds the missing side of the right triangle (e.g., 17).

Response Type: Equation/Numeric

















To als Mardal 4					
lask Model 1	Prompt Features: Student is prompted to create a plot of a given data set				
Response Type:					
Hot Spot	Stimulus Guidelines: Item difficulty can be adjusted via these				
-	example methods, but is not limited to these methods:				
DOK Level 2	Presence of repeated values in the data set				
S ID 1	Presence of clusters and/or outliers				
S-ID.I Represent data with plots	 Student creates histograms 				
on the real number line					
(dot plots, histograms,					
and box plots).	TM1b				
Fuidence Demuined.	Stimulus: The student is presented with a contextual data set				
1 The student will be	and a blank plot to be completed in order to represent the data.				
able to represent data on	Example Stem 1: Click above the numbers to create a dot plot				
the real number line with	for the given test scores.				
a dot plot, histogram, or					
box plot.	90, 45, 85, 70, 85, 50, 75, 85, 65, 75, 60, 85, 80, 65, 80				
Tools: None	Test Scores				
	0 0 0 0 0 0 0 0 0 0				
	0 0 0 0 0 0 0 0 0 0				
	0 0 0 0 0 0 0 0 0 0				
	40 50 60 70 80 90				
	Test Scores				
	Interaction: Student selects the appropriate number of circles on the dot plot given the data.				
	Bubric				
	(1 point) Student gets 100% correct (see below).				
	Test Scores				
	0 0 0 0 0 0 0 0 0 0				
	0 0 0 0 0 0 0 0 • 0				
	0 0 0 0 0 0 0 0 • 0				
	$\circ \circ \circ \circ \bullet \circ \bullet \bullet \bullet \circ$				
	$\circ \bullet \bullet \circ \bullet \bullet \bullet \bullet \bullet \bullet$				
	→ + + + + + + + + + + + + + + + + + + +				
	40 50 60 70 80 90				
	Test Scores				

HS Mathematics Item Specification C1 TP







Task Model 1	 Prompt Features: Student is prompted to find key features of a box plot given a data set. Stimulus Guidelines: Item difficulty can be adjusted via these example methods, but is not limited to these methods: The quantity of data points 				
Response Type: Drag and Drop DOK Level 2					
	Having to compute an average to determine the quartiles				
Represent data with plots on the real number line (dot plots,	TM1c Stimulus: The student is presented with a contextual data set, key features of box plots, and a number line.				
histograms, and box plots).	Example Stem: Consider these test scores.				
	91, 48, 86, 73, 86, 50, 77, 86, 64, 78, 64, 82, 68, 82, 68, 82				
Evidence Required: 1. The student will be able to	Drag each characteristic of data to the correct location on the number line.				
represent data on the real number line with a dot plot, histogram, or box	45 50 55 60 65 70 75 80 85 90 95				
plot.	Lower				
Tools: Calculator	Maximum Quartile Median				
	Upper Minimum Quartile				
	Interaction: Student drags each characteristic to the appropriate location on the number line.				
	Rubric: (2 points) Student gets all five characteristics correct. (1 point) Student gets three or four characteristics correct. Reasoning: Knowing the minimum, maximum, and median of a data set is one level of understanding, knowing the quartile is another.				
	Upper Quartile Minimum Quartile Median Maximum 45 50 55 60 65 70 75 80 85 90 95				

Response Type: Drag and Drop



Response Type: Multiple Choice, single correct response

Task Model 2

DOK Level 2

S-ID.2

Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

Evidence Required:

2. The student will be able to use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

Tools: Calculator

Prompt Features: Student is prompted to select the appropriate statistics to compare the center and/or spread based on data distributions.

Stimulus Guidelines: Student is presented with a context and two distributions.

TM2

Stimulus: The student is presented with two data distributions in which both are skewed or both are distributed normally.

Example Stem: Data distributions are shown for the quality of a farm's red apples at different points in time during the harvest season.



Which summary statistics should be used to compare the two data sets and why?

A. The median and the interquartile range because the data sets are normally distributed.

B. The median and the interquartile range because both data sets are skewed.

C. The mean and standard deviation because the data sets are normally distributed.

D. The mean and standard deviation because both data sets are skewed.

Rubric: (1 point) The student selects the correct option (e.g., B).

Response Type: Multiple Choice, single correct response



Took Madal 2	Due went Frank		:		
Response Type:	the removal or addition of outliers on the shape, center, and/or spread of the given data sets.				
Matching Tables					
DOK Level 2	 Stimulus Guidelines: Item difficulty can be adjusted via these example methods, but is not limited to these methods: Type of plots 				
S-ID.3	Student is presented with dot plots.				
Interpret differences	• Student is presented with histograms.				
in shape, center, and	• Student is presented with box plots or verbal descriptions.				
spread in the context					
of the data sets,					
accounting for	ТМЗ				
possible effects of	Stimulus: The student is presented with data sets or plots of data				
extreme data points	sets.				
(outliers).	Graphs and data sets should include at least 1 outlier.				
	Graphs a	nd data sets sho	ould each have n	o more than 20	
Evidence Required:	data valu	es.			
3. The student will be					
able to interpret the	Example Stem	1: On Monday,	Mr. Dickens aske	ed his class how	
differences in shape.	many books the	y read last mont	h and set up a c	lot plot showing the	
center and spread in	information. On	Tuesday, Walter	joined the class	s and his	
the context of the	information was	added to the do	t plot.		
data sets, 4. The					
student will be able to	Monday	's class	Tuesd	av's class	
interpret the effects	monuay s class i uesuay s class				
of outliers on the	• •				
shape center and	• •				
spread of a data set.	•		•		
	• •		• •		
Tools: Calculator	• •		• •		
	• • •		• • •		
	• • •		• • •	•	
	\bullet \bullet \bullet	•	• • •		
	* + + +	· · · ·	• • • •		
	Number	of Books	Numb	er of Books	
	Select whether the value of each statistic, for the number of book read, is greater for Monday's class, equal for both days, or greater				
	for Tuesday's cla	ass based on the	dot plots.		
		Greater for	Faual for	Greater for	
		Monday's Class	Both Days	Tuesday's Class	
	Mean				
	Median				
	Standard Deviation				
	Interaction: St	udent selects th	e correct box for	each statistic	



Example Stem 2: A car dealership has 41 cars for sale. The least expensive car costs \$11,999. The most expensive car costs			
\$19,499. Another car, priced at \$33,499, is added to the dealership's inventory. Select whether the value of each statistic, for the prices of the cars, increases, decreases, or cannot be determined when the new car is added.			
	Increases	Decreases	Cannot Be Determined
Mean			
Median			
Standard Deviation			
Interaction: S	Student selects th	e correct box for	each statistic.
Rubric: (1 poir Greater for Tue Increases, Can	nt) Student select sday's, Equal for not Be Determine	ts all of the corre Both Days, Grea ed, Increases).	ect options (e.g., ater for Tuesday's;
lesponse Typ	e: Matching Tabl	es	