Checkpoint Results Interpretation Guide

Algebra II

Tennessee Department of Education | August 2020

The Checkpoint

The Checkpoint can be used at the beginning of the school year to measure retention on **key standard-aligned skills that are most essential** for students to be able to **access, and engage in, on-grade-level content** for the current year. Because of this, the Checkpoints are smaller than a summative TCAP assessment and do not cover all the standards from the previous year. Instead, as recommended by experts[1], they focus on fewer, **prioritized vertically-aligned standards**, with the intent of providing educators more meaningful and actionable information about student needs so you can support your students' ability to access grade-level learning throughout the year.

The <u>Algebra II</u> Checkpoint should be given to <u>students who completed Algebra II in 2019-</u>20 to assist in determining readiness to access <u>higher level math content</u> this year.

To help students in their learning and teachers with their planning, Checkpoints come with fully **annotated questions** that help to understand trends and pinpoint misconceptions that may inhibit student progress. ***Using this Checkpoint Results Interpretation Guide (the Guide) and your student results data found in the Schoolnet platform, you and your students can plan for great academic success this year.***

It is best to use these results to identify any needed pre-requisite learning and incorporate it throughout the year to ensure students can access grade-level content or can build upon their current strengths. After you administer the Checkpoint and use this Guide to better meet student needs at the beginning of the year, **continue monitoring** your students' progress on **grade-appropriate assignments** for the rest of the year to ensure that these core foundations are continually strengthened.

The Checkpoint <u>IS:</u>

- an investigative tool to determine student readiness for the major work of the current grade
- aligned to the Tennessee State Academic Standards, using TN-educator reviewed questions from previous TCAP exams
- designed to identify student misconceptions and learning needs
- providing actionable next steps for informing instructional decisions

The Checkpoint <u>IS NOT:</u>

- a replacement for the performance level determinaions a student would have received on the TCAP assessment
- predictive of, or comparable to, summative TCAP results
- a replacement for RTI[2] diagnostics or universal screeners
- used to evaluate teacher, school, or district performance
- a tool to change student placement decisions (e.g. retake a course, advance to honors)

[1] https://tntp.org/assets/covid-19-toolkit-resources/TNTP_Learning_Acceleration_Guide.pdf

Contents of this Guide

"When the COVID-19 pandemic forced prolonged school building closures and canceled spring assessments, it became even more important that districts and schools can reliably gather student data and understand student readiness for the next school year. These free and optional tools are one way the department can support the needs of our district partners in serving all students"

-Commissioner Penny Schwinn

Checkpoint Design

The Checkpoint assessments were designed using **real TCAP questions** from previous summative exams. This ensured each question was aligned to Tennessee state standards and had been reviewed by **Tennessee educators**. The Checkpoint was designed to be quick to access and administer, not requiring complicated adjustments to existing school schedules; with **flexibility for online or paper administration** based on school/district need.

The Math Checkpoint assessments:

1. **are quick easy to administer**: contain two subparts (separated by a section break and new instructions screen) in one short (less than 30 questions) assessment in Schoolnet
2. **include prioritized content:** standards, concepts, and skills from the designated grade-level/course that are considered essential pre-requisite content for accessing the next grade-level's work

Less than 60 minutes

Less than 30 questions

Two subparts: Calculator & Non-Calculator

Interpreting and Using Results

Automatic Reporting in Schoolnet

In order to support teachers in using these assessments, students who take the assessment online in the Schoolnet platform will have their Checkpoints scored automatically. Teachers have multiple scoring options for students who take the Checkpoints on paper, and you can find how-to documents and videos at https://tn.mypearsonsupport.com/schoolnet/. **Checkpoint assessment scoring in Schoolnet requires all answers to be submitted by the student for results to be produced.** The following automated reports can be found in Schoolnet:

- Individual student results
- Classroom level reports
- Standards analysis reports
- Item analysis
- Test comparison reports (e.g., student, class, school, district, and state)
- Shared reporting (e.g., district to school admin, school admin to educators in same content/grade-level)
- Aggregate and disaggregation of demographics

Overall Scores

The score groups on the checkpoint assessment are ***not* meant to represent performance levels or the blueprints of the TCAP summative assessments** (e.g., below, approaching, on track, and mastered). The score groups were designed to **share student preparedness for next grade level content** and provide guidance around the **level of support** students may need to access that content.

Score Group	% Correct	Results	Recommended Next Steps
Orange	**0 – 49%**	**Likely Needs More Targeted Support**	Use other sources of data for deeper insight; use identified misconceptions to offer targeted re-teaching, plan differentiation and intervention as needed as grade-level concepts are introduced.
Yellow	**50 – 67%**	**Likely Able to Engage in Grade Level Content with Some Support**	Investigate trends in student responses using the most important errors, to support differentiation on grade-level assignments and scaffolding when introducing new content; provide opportunities to check for understanding throughout the lesson to determine differentiation needs.
Green	**68 – 99%**	**Likely Ready for Grade Level Content**	Move directly into grade-level content.
Blue	**100%**	**Ready for Grade Level Content**	

Overall scoring is automatically available in the Schoolnet platform. This may help with you use the results of the student and class level reports to develop an overall summary and conclusion about your students' readiness for grade-level content. In responding to the Checkpoint assessments, we recommend addressing the learning needs of students **while engaging with on grade-level content**. For more information and tools for using assessment data to drive instructional decision making, review the Assessing Learning Toolkit, pages 18-21, and the Learning Loss PLC Guide.

While overall scoring is provided and can be helpful in planning for group instruction, the most actionable information in these Checkpoints can be found by analyzing at the question-level results.

Actionable Insights: Annotated Questions and Reporting Tools

Each question on the Checkpoint is fully annotated with information that describes the questions as they were used on previous TCAP tests, and automated scoring tools in Schoolnet that make getting that information easier. The most helpful and actionable information is in the **Item Annotations in this Guide** when combined with the **Item Analysis reports in Schoolnet**.

When we need more time *in the school year, the best way to get it is to spend less time on things they've already mastered and more time on the specific gaps that students need.*

Answer Choice Rationales in each Question Annotation

It is possible that we have multiple students who may not have mastered some of the foundational content required to fully engage in this year's content. We are most effective at addressing these needs when we can pinpoint, as specifically as possible, the conceptual understanding that would most efficiently close this gap. That way we spend less time on previous content by focusing just on the piece that they need to be successful with this concept during the year. The Question Annotations are designed to help with that process.

To help teachers be more efficient in planning for the year, each question on the Checkpoint is accompanied by a set of answer choice rationales **which offers an explanation for each choice**. These annotations are not definitive: we know there may be many reasons for why students might select different answer choices. However, each rationale listed provides an explanation for why students may have selected a given answer choice, including what mis-steps may have caused them to select an incorrect answer (a "distractor"). These distractor rationales provide an instructional target to improve student understanding by breaking down and diagnosing the likely conceptual mistake, allowing you to **follow up with targeted instruction based on the most common mathematical errors you identify** for your specific group of students. These annotations assume that students tried their best and cannot provide information about whether students selected an option at random.

Item Annotations and Planning for Instruction

The department recommends in using this guide that educators look for trends in incorrect answers using the Item Analysis reporting on Schoolnet and then use the annotations using this process:

1. Find the highest-leverage error trend,
   A. This can mean comparing the frequency of each student error or understanding the group of students represented by that trend.
2. Unpack the conceptual misunderstanding that led to the most important error, and then use the annotations to support analyzing the incorrect answer by thinking through these questions in order:
   A. What DO these students understand?
   B. Based on what students do understand, why might a student think their error was a reasonable choice?
   C. What specific concept, if they had understood it clearly, would have made them recognize that the error was not a reasonable approach?
3. Put it all together to check your thinking by restating the answers to each of the three questions to articulate this sentence stem:

"Students understood [question A] but made the error of [student error], because they thought [question B] made sense. If they had understood [question C], they would have avoided the error."

This practice of pinpointing misconceptions and target understandings can help with long term planning to support students in accessing year-long content and making the most of the start of year Checkpoint.

Sample Set of Rationales

Rationales	
Incorrect – 1	Students choosing this answer likely skipped a step in multiplying (7×10). Students choosing this answer may need additional support in setting up the multiplication algorithm and tracking that they multiply each multiplicand by the multiplier.
Incorrect – 2	Students choosing this answer likely skipped multiplying 7 by the tens place, instead adding the regrouped 30 to the ten in the multiplicand. Students choosing this answer may need additional support in multiplying with regrouping.
Correct – 3	This problem requires students to understand the process involved to multiply a whole number of four digits by a one-digit whole number and using strategies based on place value and the properties of operations. To determine the correct product, students should have multiplied the multiplicand (2,815) by the multiplicator (7) while remembering to regroup correctly.
Incorrect – 4	Students choosing this answer likely added the regrouped tens (30) before multiplying by 7. Students choosing this answer may need additional support or practice in the order of operations while multiplying a whole number of four digits by a one-digit whole.

Algebra II Checkpoint Item Annotations

Item Information

Item Code: TN248122 Grade Level:

Algebra II Standard Code: A2.A.REI.A.2 Position No: 1

Standard Text: Solve rational and radical equations in one variable, and identify extraneous solutions when they exist.

Calculator: N

Correct Answer: C

What is the value of x in the following equation?

$$\sqrt{x-4} = 9$$

A. $x = 7$

B. $x = 10$

C. $x = 85$

D. $x = 169$

Rationales	
Incorrect – 1	Students may have selected this option because they evaluated the square root of the right-hand side instead of squaring both sides of the equation in order to “cancel” out the square root. Students who chose this option may need support in understanding the effects of operations when acting upon an equation, especially with implicit groupings (e.g. radical expressions, numerators) in order to select an operation to use.
Incorrect – 2	Students may have selected this option because they subtracted 4 from both sides of the equation, misunderstanding the interpretation of the square root. Students who chose this option may need support in understanding the effects of operations when acting upon an equation, especially with implicit groupings (e.g. radical expressions, numerators) in order to select an operation to use.
Correct – 3	This problem requires students to understand how to solve radical equations. Students should have understood how to use opposite operations to solve this equation, resulting in $x = 85$.
Incorrect – 4	Students may have selected this option because they added 4 to both sides of the equation, disregarding the square root initially. Students who chose this option may need support in understanding the effects of operations when acting upon an equation, especially with implicit groupings (e.g. radical expressions, numerators) in order to select an operation to use.

Item Information

Item Code: TN546541 | Grade Level: Algebra II

Standard Code: A2.F.BF.A.2 | Position No: 2

Standard Text: Write arithmetic and geometric sequences with an explicit formula and use them to model situations.

Calculator: N

Correct Answer: B

Which of these is a formula that can be used to determine the *n*th term of the arithmetic sequence 15, 27, 39,51, . . .?

A. $a_n = 3n + 12$

B. $a_n = 12n + 3$

C. $a_n = 12n + 15$

D. $a_n = 15n + 12$

Rationales	
Incorrect – 1	Students may have selected this option because they may have understood how to find the common difference in an arithmetic sequence but did not understand that the common difference needed to be multiplied by n in the explicit formula. They also may have found an initial value that worked for this sequence. Students who chose this option may need support in understanding which part of the formula represents the common difference.
Correct – 2	Students were correctly able to represent an arithmetic sequence with an explicit formula. Students found the common difference and applied the formula $a_n = a_1 + (n - 1)d$.
Incorrect – 3	Students may have selected this option because they understood how to find the common difference in an arithmetic sequence but may have then used the first term in the sequence as the other part of the equation, instead of using the formula. Students who chose this option may need support in understanding how to use the general formula to determine an explicit formula for an arithmetic sequence.
Incorrect – 4	Students may have selected this option because they understood how to find the common difference in an arithmetic sequence but did not understand that the common difference needed to be multiplied by n in the explicit formula. They may have then used the first term in the sequence as the second part of the equation. Students who chose this option may need support in understanding how to use the general formula to determine an explicit formula for an arithmetic sequence and which part of the formula represents the common difference.

Item Information

Item Code: TN416721 Grade Level: Algebra II

Standard Code: A2.A.REI.A.1 Position No: 3

Standard Text: Explain each step in solving an equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Calculator: N

Correct Answer: A

Which property was used to rewrite the equation $2^x - 7 = 1$ as $2^x = 8$?

A. Addition Property of Equality

B. Commutative Property

C. Multiplicative Inverse

D. Substitution Property of Equality

Rationales	
Correct – 1	Students were correctly able to justify a solution method in solving an equation. Students recognized that 7 had to be added to both sides of the equation. Students recognized that this step is justified by the Addition Property of Equality.
Incorrect – 2	Students may have selected this option because they may have recognized that the -7 was moved to the other side of the equation and assumed this represented the Commutative Property. Students who chose this option may need support in understanding and recognizing the properties of real numbers to construct a viable argument to justify a solution method.
Incorrect – 3	Students may have selected this option because they may have reasoned that the -7 was moved to the other side of the equation by division (Multiplicative Inverse). Students who chose this option may need support in understanding and recognizing the properties of real numbers to construct a viable argument to justify a solution method.
Incorrect – 4	Students may have selected this option because they may have reasoned that the -7 and 1 were substituted with 8 and this represented Substitution Property of Equality. Students who chose this option may need support in understanding and recognizing the properties of real numbers to construct a viable argument to justify a solution method.

Item Information

Item Code: TN041453 | Grade Level: Algebra II

Standard Code: A2.N.RN.A.1 | Position No: 4

Standard Text: Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.

Calculator: N

Correct Answer: C

Which number, when raised to the power of 5, equals 2?

A. $\frac{1}{5}$

B. $\frac{2}{5}$

C. $2^{\frac{1}{5}}$

D. $32^{\frac{1}{5}}$

Rationales	
Incorrect – 1	Students may have selected this option because they multiplied the given values to get 10, and then multiplied that by $\frac{1}{5}$ to get 2. Students who chose this option may need support in ensuring they understand the task required and on understanding the properties of exponents.
Incorrect – 2	Students may have selected this option because they multiplied the value of $\frac{2}{5}$ by 5 instead of raising to the power of 5. Students who chose this option may need support in understanding the properties of exponents.
Correct – 3	Students were correctly able to extend the properties of integer exponents to rational exponents to evaluate an expression. The student raised $2^{\frac{1}{5}}$ to the power of 5 and simplified.
Incorrect – 4	Students may have selected this option because they evaluated 2^5 first, misunderstanding the what the problem represents. Students who chose this option may need practice transitioning between verbal and algebraic representations of mathematical relationships.

Item Information

Item Code: TN246034 | Grade Level: Algebra II

Standard Code: A2.N.RN.A.2 | Position No: 5

Standard Text: Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Calculator: N

Correct Answer: D

Which expression shows $\left(\sqrt[3]{8x}\right)^2$ rewritten with rational exponents?

A. $3(8x)^{\frac{1}{2}}$

B. $2\left(8x^{\frac{1}{3}}\right)$

C. $\left(8x^{\frac{1}{2}}\right)^3$

D. $(8x)^{\frac{2}{3}}$

Rationales	
Incorrect – 1	Students may have selected this option because they may have confused what the root and exponent represent. Students who chose this option may need support in understanding what the different parts of a radical expression represent.
Incorrect – 2	Students may have selected this option because they may have confused what the exponent represents. They rewrote the power of 2 as a coefficient in front of the expression. They correctly wrote the root as a fractional exponent but did not include the entire base. Students who chose this option may need support in understanding what exponents mean in radical expressions, and to work on keeping the entire base together when changing from radical to exponential form.
Incorrect – 3	Students may have selected this option because they may have confused the meanings of the root and exponents. Students who chose this option may need support in understanding what the different parts of a radical expression represent as well as on keeping the entire base together when changing from radical to exponential form.
Correct – 4	Students were correctly able to be able to rewrite expressions involving radicals using rational exponents and the properties of exponents. Students understood that a cube root is equivalent to raising the base to the $\frac{1}{3}$ power and that a power raised to another power is equivalent to multiplying the two powers.

Item Information

Item Code: TN439812 Grade Level: Algebra II

Standard Code: A2.A.SSE.A.1 Position No: 6

Standard Text: Use the structure of an expression to identify ways to rewrite it.

Calculator: N

Correct Answer: A,B,E

Select **all** expressions that are equivalent to $3x^5 - 6x^4y + 3x^3y^2$.

A. $3x^3(x - y)^2$

B. $3x^3(x^2 - 2xy + y^2)$

C. $3x^3(x + y)^2$

D. $3x^3(x - y)(x + y)$

E. $3x^3(x - y)(x - y)$

Rationales	
Correct – 1	Students were correctly able to use the structure of an expression and polynomial factoring to identify ways to rewrite it. Students recognized and factored out the greatest common factor. Students then recognized the trinomial can be factored further and since the binomial repeats itself, it could be rewritten using exponents.
Correct – 2	Students were correctly able to use the structure of an expression and polynomial factoring to identify ways to rewrite it. Students recognized and factored out the greatest common factor.
Incorrect – 3	Students may have selected this option because they may have factored out the greatest common factor. The student then may have tried to further factor the trinomial but made a mistake in the signs of the resulting binomial. Students who chose this option may need support in factoring trinomials, paying close attention to the signs of the terms.
Incorrect – 4	Students may have selected this option because they may have factored out the greatest common factor. The student then may have tried to further factor the trinomial but made a mistake in the signs of the resulting binomial. Students who chose this option may need support in factoring trinomials, paying close attention to the signs of the terms.
Correct – 5	Students were correctly able to use the structure of an expression and polynomial factoring to identify ways to rewrite it. Students recognized and factored out the greatest common factor. Students then recognized the trinomial can be factored further.

Item Information

Item Code: TN346669 Grade Level: Algebra II

Standard Code: A2.F.BF.A.2 Position No: 7

Standard Text: Write arithmetic and geometric sequences with an explicit formula and use them to model situations.

Calculator: Y

Correct Answer: D

Every year Beth doubles the amount of money she donates to charity. She donated $1 to charity at age 10.

How much money will she donate at age 20?

A. $21

B. $41

C. $512

D. $1,024

Rationales	
Incorrect – 1	Students may have selected this option because they may have reasoned that this item expressed an arithmetic sequence and wrote the equation using $a_n = a_1 + dn$ as the general formula, and evaluated for $n = 10$. Students who chose this option may need support in understanding how sequences represent patterns in mathematical relationships, with practice identifying these patterns in real-world situations and in sequence formulas.
Incorrect – 2	Students may have selected this option because they may have reasoned that this item expressed an arithmetic sequence and wrote the equation using $a_n = a_1 + dn$ as the general formula, and evaluated for $n = 20$. Students who chose this option may need support in understanding how sequences represent patterns in mathematical relationships, with practice identifying these patterns in real-world situations and in sequence formulas.
Incorrect – 3	Students may have selected this option because they may have realized this item expressed a geometric sequence, wrote the equation, but mistakenly evaluated the formula for $n = 10$ determine the amount $512. These students may need practice articulating what a computation represents in real-world problems in order to interpret its reasonableness.
Correct – 4	This problem requires students to write and evaluate an explicit formula for geometric sequences. The student realized this item expressed a geometric sequence, wrote and evaluated the formula for $n = 11$ to determine the amount $1,024.

Item Information

Item Code: TN741458 | Grade Level: Algebra II

Standard Code: A2.A.SSE.B.3 | Position No: 8

Standard Text: Recognize a finite geometric series (when the common ratio is not 1), and use the sum formula to solve problems in context.

Calculator: Y

Correct Answer: C

A post is being driven into the ground. The first strike drives the post 25 inches into the ground. Each additional strike drives the stake $\frac{4}{5}$ the distance farther into the ground than the previous strike (20 inches, 16 inches, . . .).

What is the total distance (to the nearest inch) that the post is driven into the ground after 7 strikes?

A. 79

B. 92

C. 99

D. 104

Rationales	
Incorrect – 1	Students may have selected this option because they may have did not recognize this involves a geometric series. Students who chose this option may need support in understanding how sequences represent patterns in mathematical relationships, with practice identifying these patterns in real-world situations and in sequence formulas.
Incorrect – 2	Students may have selected this option because they may have recognized this was a geometric series but used $n - 1$, instead of n. Students who chose this option may need support in understanding how sequences represent patterns in mathematical relationships, with practice identifying these patterns in real-world situations and in sequence formulas.
Correct – 3	Students were correctly able to recognize a finite geometric series (when the common ratio is not 1) and use the formula to calculate the sum. The student recognized this was a geometric series, applied the formula, determined the sum, and rounded to the nearest inch to get 99 inches.
Incorrect – 4	Students may have selected this option because they may have recognized this was a geometric series, but used $n + 1$, instead of n. Students who chose this option may need support in understanding how sequences represent patterns in mathematical relationships, with practice identifying these patterns in real-world situations and in sequence formulas.

Item Information

Item Code: TN241436 | Grade Level: Algebra II

Standard Code: A2.A.CED.A.1 | Position No: 9

Standard Text: Create equations and inequalities in one variable and use them to solve problems.

Calculator: Y

Correct Answer: D

Joyce deposited \$5000 in an account with an annual interest rate of 6%, compounded annually. How much money will be in the account 10 years later?

A. \$3954.24

B. \$5600.00

C. \$8000.00

D. \$8954.24

Rationales	
Incorrect – 1	Students may have selected this option because they may have recognized this was an interest problem and found the amount in the account. Students may have misunderstood the question being asked, because once getting this amount, they subtracted the principle from this total. These students may need practice articulating what each value and variable represents in real-world problems in order to interpret their mathematical relationships in exponential relationships.
Incorrect – 2	Students may have selected this option because they may have recognized this was an interest problem but did not know the formula to use. They may have used $60 as the yearly interest amount, multiplied by 10, and added to the principal. Students who chose this option may need support in recognizing interest problems and the formula used to evaluate them.
Incorrect – 3	Students may have selected this option because they may have recognized this was an interest problem. The students may have found the simple interest by multiplying the principal, rate, and time and adding this back to the principal. Students who chose this option may need support in understanding the difference between simple and compound interest and the formula involved with both.
Correct – 4	Students were correctly able to create an equation in one variable and use it to solve a problem. Students recognized this was an interest problem, used the general formula for interest, and evaluated for the given values.

Item Information

Item Code: TN746805 Grade Level: Algebra II

Standard Code: A2.A.REI.D.6 Position No: 10

Standard Text: Explain why the x-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); find the approximate solutions using technology.

Calculator: Y

Correct Answer: A

The functions $f(x) = (x - 2)^2$ and $g(x) = 4 - x^2$ are graphed on a coordinate plane.

What is the relationship between the graphs and the solutions of the equation $(x - 2)^2 = 4 - x^2$?

A. $x = 0$ and $x = 2$ are solutions because $f(0) = g(0)$ and $f(2) = g(2)$.

B. The ordered pair $(0, 4)$ is the solution because $f(0) = 4$ and $g(0) = 4$.

C. $x = -2$ and $x = 2$ are solutions because they are the x-intercepts of both functions.

D. The ordered pair $(2, 0)$ is the solution because it is the only point where the graphs of both $f(x)$ and $g(x)$ cross the x-axis.

Rationales	
Correct – 1	Students were correctly able to explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$. Students recognized that this option correctly establishes that since $f(0) = g(0)$ and $f(2) = g(2)$ then $x = 0$ and $x = 2$ are solutions to the given equation.
Incorrect – 2	Students may have selected this option because they understood they were looking for a point that both equations shared, however the student only identified one solution instead of both solutions. Students who chose this option may need support in understanding how to find all solutions of a system of equations, when one is substituted into the other, either using algebra or technology.
Incorrect – 3	Students may have selected this option because they understood they were looking for a point that both equations shared, however, the students confused the solution of two equations being set equal to each other with the solutions of an equation set equal to zero, using the x-intercepts of the two equations as the solutions instead of the intersection points of the two graphs. Students who chose this option may need support in understanding how to find the solution of a system of equations, when one is substituted into the other, either using algebra or technology.
Incorrect – 4	Students may have selected this option because they understood they were looking for a point that both equations shared. However, the students confused the solution of two equations being set equal to each other with the solutions of an equation set equal to zero, using the x-intercept the two graphs share as the solution, without realizing there was another solution. Students who chose this option may need support in understanding how to find all solutions of a system of equations, when one is substituted into the other, either using algebra or technology.

Item Information

Item Code: TN313982 Grade Level: Algebra II

Standard Code: A2.A.CED.A.1 Position No: 11

Standard Text: Create equations and inequalities in one variable and use them to solve problems.

Calculator: Y

Correct Answer: B

A decorative fence surrounds a rectangular flower garden that is 2 yards long and 3 yards wide. The area of the garden is increased by 20%.

If the width remains the same, what is the new length of the garden?

A. 1.6 yards

B. 2.4 yards

C. 3.6 yards

D. 7.2 yards

Rationales	
Incorrect – 1	Students may have selected this option if they found the amount of change in the length but subtracted this amount from the original length. These students may need practice articulating what each value and variable represents in real-world problems—both values that are given and those that are needed to answer a question—in order to set up mathematical expressions using those variables.
Correct – 2	Students were correctly able to create an equation in one variable and use it to solve a problem. The student may have recognized that the increased area of the garden is represented by 1.2 times 6. Since the width does not change, the student may have used the equation $7.2 = L \times 3$ to find the new length of 2.4 yards.
Incorrect – 3	Students may have selected this option if they increased the width by 20%, instead of the length. These students may need practice articulating what each value and variable represents in real-world problems—both values that are given and those that are needed to answer a question—in order to set up mathematical expressions using those variables.
Incorrect – 4	Students may have selected this option if they increased the area by 20%. These students may need practice articulating what each value and variable represents in real-world problems—both values that are given and those that are needed to answer a question—in order to set up mathematical expressions using those variables.

Item Information

Item Code: TN541442 | Grade Level: Algebra II

Standard Code: A2.A.REI.D.6 | Position No: 12

Standard Text: Explain why the x-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); find the approximate solutions using technology.

Calculator: Y

Correct Answer: A

Consider the functions shown.

$$f(x) = |x + 2|$$
$$g(x) = x + 8$$

What is the solution to $f(x) = g(x)$?

A. (–5, 3)

B. (–3, 1)

C. (–2, –8)

D. (0, 8)

Rationales	
Correct – 1	Students were correctly able to explain why the *x*-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$, and use technology to find the solutions. Students found that the point $(-5, 3)$ was on both graphs.
Incorrect – 2	Students may have selected this option because they found a point that was on $f(x)$ but not $g(x)$. Students who chose this option may need support in understanding what a solution to a system of equations means, with practice transitioning between and interpreting different representations of these mathematical relationships, going to and from each of the following: words, tables (points), graphs, and equations/expressions
Incorrect – 3	Students may have selected this option because they used the *x*-intercept of each graph to create a "solution" of the *x*-coordinates of the *x*-intercepts. Students who chose this option may need support in understanding what a solution to a system of equations means, with practice transitioning between and interpreting different representations of these mathematical relationships, going to and from each of the following: words, tables (points), graphs, and equations/expressions
Incorrect – 4	Students may have selected this option because they found a point that was on $g(x)$ but not $f(x)$. Students who chose this option may need support in understanding what a solution to a system of equations means, with practice transitioning between and interpreting different representations of these mathematical relationships, going to and from each of the following: words, tables (points), graphs, and equations/expressions

Item Information

Item Code: TN441491 Grade Level: Algebra II
Standard Code: A2.A.APR.A.1 Position No: 13
Standard Text: Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x).
Calculator: Y
Correct Answer: A

A polynomial, $f(x)$, is divided by four different linear expressions, as listed in the table. The resulting remainders after the division by each linear expression are as shown in the table.

Linear Expression	**Remainder**
$x - 1$	0
$x + 1$	–4
$x - 3$	2
$x + 3$	0

Which must be a root of the polynomial equation?

A. -3

B. -1

C. 2

D. 3

Rationales	
Correct – 1	Students were correctly able to apply the Remainder Theorem to determine a root of a polynomial equation. Students may have recognized that the table showed two expressions that resulted in a remainder of 0, meaning two roots of the polynomial were 1 and -3, leading them to choose -3.
Incorrect – 2	Students may have selected this option because they recognized that the table showed $(x-1)$ as having a remainder of 0. However, they made a sign error and chose -1. Students who chose this option may need support in converting from factors of polynomials to the roots and why setting the factor equal to 0 can support this.
Incorrect – 3	Students may have selected this option because they may have recognized that the table showed two expressions that resulted in a remainder of 0, then misapplied the Remainder Theorem and selected 2, representing the number of roots that were shown in the table. Students who chose this option may need support understanding what is mathematically represented in key polynomial terms (e.g. root, polynomial division).
Incorrect – 4	Students may have selected this option because they recognized that the table showed $(x+3)$ as having a remainder of 0. However, they made a sign error and chose 3. Students who chose this option may need support in converting from factors of polynomials to the roots and why setting the factor equal to 0 can support this.

Item Information

Item Code: TN516743 | Grade Level: Algebra II
Standard Code: A2.F.IF.A.1 | Position No: 14
Standard Text: 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.
Calculator: Y
Correct Answer: A,D,E

A craft store sells wooden boxes shaped like rectangular prisms. They come in heights from 5 inches to 10 inches. The table represents the function $f(x)$, which gives the volume of a box as a function of its height.

Height (in.)	5	6	7	8	9	10
Volume (in.^3)	210	336	504	720	990	1,320

Which statements accurately describe the function $f(x)$?

Select **all** that apply.

A. The function is increasing.

B. The volume increases by a common factor of 1.6.

C. The function is decreasing.

D. The function is **not** linear.

E. The maximum value of the function is 1,320.

Rationales	
Correct – 1	Students were correctly able to understand how to interpret key features of graphs and tables in terms of the quantities for a function that models a relationship between two quantities. Students may have recognized that as the value of x (height) increased, the value of y (volume) also increased.
Incorrect – 2	Students may have selected this option by determining the factor between the first two points in the table, not realizing this ratio did not hold true for further points. Students who chose this option may need support in understanding common factors and the need for them to hold no matter which two consecutive points they look at.
Incorrect – 3	Students may have selected this option because they confused increasing and decreasing, and what those two looked like in table form. Students who chose this option may need practice transitioning between and interpreting different representations of the same mathematical relationship, going to and from each of the following: words, tables (points), graphs, and equations/expressions.
Correct – 4	Students were correctly able to understand how to interpret key features of graphs and tables in terms of the quantities for a function that models a relationship between two quantities. Students may have recognized the there was no common difference in y-values, therefore no constant slope. This means this is not a linear function.
Correct – 5	Students were correctly able to understand how to interpret key features of graphs and tables in terms of the quantities for a function that models a relationship between two quantities. Students may have recognized that since $x = 10$ is the largest y-value would be the maximum value of the function. This leads to 1,320 as the maximum value of the function.

Item Information

Item Code: TN0002997 Grade Level: Algebra II

Standard Code: A2.A.APR.A.2 Position No: 15

Standard Text: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Calculator: Y

Correct Answer: D

Four students rewrote the function $y = 6x^2 + 27x - 15$ in factored form and stated the zeros.

Which solution correctly shows the function in factored form and identifies the zeros of the function?

A. $y = (6x - 3)(x + 5)$ zeros: 2 and -5

B. $y = (6x - 3)(x + 5)$ zeros: -2 and 5

C. $y = 3(2x - 1)(x + 5)$ zeros: -0.5 and 5

D. $y = 3(2x - 1)(x + 5)$ zeros: 0.5 and -5

Rationales	
Incorrect – 1	Students may have selected this option because they may have factored the given function correctly and set the factors equal to zero, but solved the equation with a leading coefficient incorrectly. Students who chose this option may need support in solving equations using opposite operations.
Incorrect – 2	Students may have selected this option because they may have factored the given function correctly and set the factors equal to zero, but solved the first equation with a leading coefficient incorrectly and made sign errors on both when solving. Students who chose this option may need support in solving equations using opposite operations.
Incorrect – 3	Students may have selected this option because they may have factored the given function correctly and set the factors equal to zero, but made sign errors when solving. Students who chose this option may need support in solving equations using opposite operations.
Correct – 4	Students were correctly able to identify zeros of polynomials when suitable factorizations are available. The students factored the given function correctly, set the factors equal to zero, and solved.

Item Information

Item Code: TN341360 Grade Level: Algebra II

Standard Code: A2.A.REI.D.6 Position No: 16

Standard Text: Explain why the x-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); find the approximate solutions using technology.

Calculator: Y

Correct Answer: A

Which system of equations has only **one** solution?

A. $y = x + 5$ and $y = -3x + 6$

B. $y = x - 2$ and $y = x + 4$

C. $y = |x - 5|$ and $y = 0.2x + 1$

D. $y = x^2 - 1$ and $y = 1.5x + 1$

Rationales	
Correct – 1	Students were correctly able to determine the number of solutions a system of equations has.
Incorrect – 2	Students may have selected this option because they assumed the lines represented by the given equations would intersect once because they have different *y*-intercepts. Students who chose this option may need support in understanding what a solution to a system of equations means, with practice transitioning between and interpreting different representations of these mathematical relationships, going to and from each of the following: words, tables (points), graphs, and equations/expressions
Incorrect – 3	Students may have selected this option because they assumed the graphs of the given equations would intersect once because of the shape of the absolute value graph. Students who chose this option may need support in understanding what a solution to a system of equations means, with practice transitioning between and interpreting different representations of these mathematical relationships, going to and from each of the following: words, tables (points), graphs, and equations/expressions
Incorrect – 4	Students may have selected this option because they assumed the graphs of the given equations would intersect once because of the shape of the quadratic graph. Students who chose this option may need support in understanding what a solution to a system of equations means, with practice transitioning between and interpreting different representations of these mathematical relationships, going to and from each of the following: words, tables (points), graphs, and equations/expressions

Item Information

Item Code: TN816732 | Grade Level: Algebra II

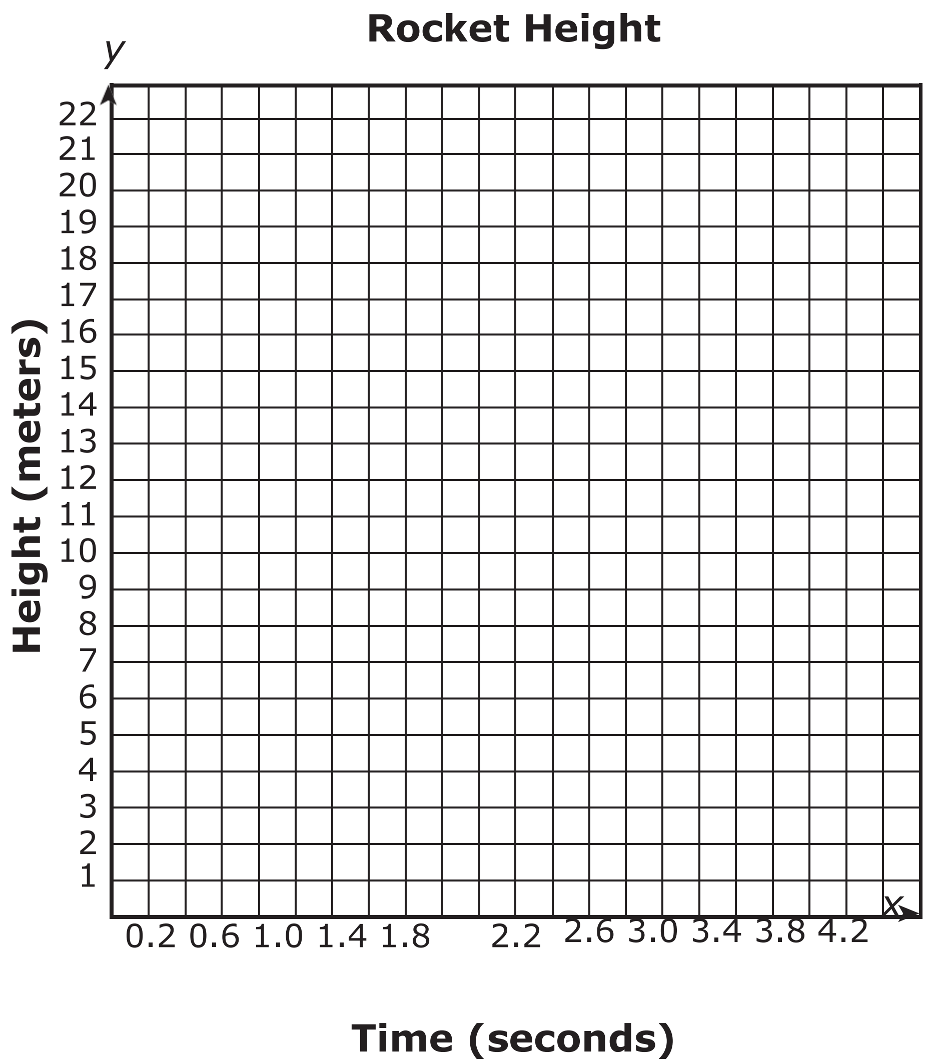
Standard Code: A2.F.IF.A.1 | Position No: 17

Standard Text: 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.

Calculator: Y

Correct Answer: A,C,D

The graph of $h(x)$ shows the height, in meters, of a rocket x seconds after it was launched from a platform.



Which statements accurately describe the function $h(x)$?

(This item continues on the next page.)

*(**Item 17**, continued from the previous page)*

Select **all** that apply.

A. The graph changes from increasing to decreasing.

B. The range is $4 \le y \le 22$.

C. The rocket is in the air for 4 seconds.

D. The rocket reaches a maximum height of 22 meters.

E. The rocket has a greater distance to travel upward than downward.

Rationales	
Correct – 1	Students were correctly able to understand how to interpret key features of graphs in terms of the quantities for a function that models a relationship between two quantities. The student may have recognized that from $x = 0$ to $x = 1.9$, $f(x)$ is increasing as x increases, and from $x = 1.9$ to $x = 40$, $f(x)$ is decreasing as x increases.
Incorrect – 2	Students may have selected this option because they did not consider the whole graph, especially the *y*-values for *x* from 3.8 to 4.0 where they are between 0 and 4. Students who chose this option may need support in recognizing the range of a function that may not be symmetrical.
Correct – 3	Students were correctly able to understand how to interpret key features of graphs in terms of the quantities for a function that models a relationship between two quantities. The student may have recognized the rocket is launched from a height of 4 meters and lands back on the ground when $x = 4$ seconds, so it has a flight time of 4 seconds.
Correct – 4	Students were correctly able to understand how to interpret key features of graphs in terms of the quantities for a function that models a relationship between two quantities. The student may have recognized that the maximum height occurs at 1.9 seconds, and the height of the rocket is 22 meters.
Incorrect – 5	Students may have selected this option because they might have mixed up the distance the rocket travels going up / down. The rocket travels 22 - 4 = 18 meters upward but travels 22 - 0 = 22 meters downward. These students may need practice articulating what each value and variable represents in real-world problems in order to interpret their mathematical relationships and real-world constraints.

Item Information

Item Code: TN013606 — Grade Level: Algebra II

Standard Code: A2.A.APR.A.2 — Position No: 18

Standard Text: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Calculator: Y

Correct Answer: A

What are the real zeros of the function $f(x) = x^4 - 3x^3 + 2x^2 - 6x$?

A. $x = 0$ and $x = 3$

B. $x = 0$ and $x = -3$

C. $x = -\sqrt{2}$, $x = 0$, $x = \sqrt{2}$, and $x = -3$

D. $x = -\sqrt{2}$, $x = 0$, $x = \sqrt{2}$, and $x = 3$

Rationales	
Correct – 1	Students were correctly able to factor a polynomial and use those factors to identify the zeros of the given polynomial. The student correctly factored the polynomial, then set each factor equal to zero and solved.
Incorrect – 2	Students may have selected this option if they understood how to factor the polynomial, set each factor equal to zero and solved, making a sign error on the final factor. Students who chose this option may need support in solving equations using opposite operations.
Incorrect – 3	Students may have selected this option if they understood how to factor the polynomial, set each factor equal to zero and solved. When solving, they made an error in not recognizing that the square root of a negative is not real; also, they made a sign error on the final factor. Students who chose this option may need support in solving equations using opposite operations and understanding when you can take the square root of a number to end up with a real solution.
Incorrect – 4	Students may have selected this option if they understood how to factor the polynomial, set each factor equal to zero and solved. When solving, they made an error in not recognizing that the square root of a negative is not real. Students who chose this option may need support in understanding when you can take the square root of a number to end up with a real solution.

Item Information

Item Code: TN246051 — Grade Level: Algebra II

Standard Code: A2.N.RN.A.2 — Position No: 19

Standard Text: Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Calculator: Y

Correct Answer: B,D,F

Which expressions are equivalent to $27^{\frac{4}{3}}$?

Select the **three** correct answers.

A. 4^3

B. $\left(27^{\frac{1}{3}}\right)^4$

C. $3^{\frac{1}{4}}$

D. 81

E. $3\sqrt{4}$

F. $(\sqrt[3]{27})^4$

Rationales	
Incorrect – 1	Students may have selected this option because they understood some of the properties of exponents. Students who chose this option may need support in using the properties of exponents to rewrite and evaluate expressions with rational exponents.
Correct – 2	Students were correctly able to understand how to rewrite and evaluate expressions involving radicals and rational exponents. The student may have understood they could rewrite $27^{\frac{4}{3}}$ $(27^{\frac{1}{3}})^{4}$.
Incorrect – 3	Students may have selected this option because they understood some of the properties of exponents. Students who chose this option may need support in using the properties of exponents to rewrite and evaluate expressions with rational exponents.
Correct – 4	Students were correctly able to understand how to rewrite and evaluate expressions involving radicals and rational exponents. The student may have understood they could rewrite $27^{\frac{4}{3}}$ $(27^{\frac{1}{3}})^{4}$ and 27 as 3^3, simplifying to 81.
Incorrect – 5	Students may have selected this option because they understood some of the properties of exponents. Students who chose this option may need support in using the properties of exponents to rewrite and evaluate expressions with rational exponents.
Correct – 6	Students were correctly able to understand how to rewrite and evaluate expressions involving radicals and rational exponents. The student may have understood that for a fractional exponent, the denominator represents the root of the equivalent radical, while the numerator remains an exponent, leading to $(\sqrt[3]{27})^4$.

Item Information

Item Code: TN341464 Grade Level: Algebra II

Standard Code: A2.F.BF.A.1.a Position No: 20

Standard Text: Determine an explicit expression, a recursive process, or steps for calculation from a context.

Calculator: Y

Correct Answer: A

The value of a motorcycle each year follows the sequence $12,000, $9,600, $7,680, $6,144, . . .

Which formula represents the recursive definition of the sequence where n represents the number of years?

A. $a_n = a_{n-1}(0.8)$

B. $a_n = a_{n-1} - 2{,}400$

C. $a_n = a_{n+1}(0.8)$

D. $a_n = a_{n-1}\left(\frac{5}{4}\right)$

Rationales	
Correct – 1	Students were correctly able to write a function using a recursive process that describes a relationship between two quantities. Students may have determined that this is best represented by a geometric sequence with a common ratio of 0.8.
Incorrect – 2	Students may have selected this option if they mistook the sequence as arithmetic a linear function. Students who chose this option may need support in understanding how sequences represent patterns in mathematical relationships, with practice identifying these patterns in real-world situations.
Incorrect – 3	Students may have selected this option if they understood this sequence is best represented by a geometric sequence because it has a common ratio but may have reasoned that $n + 1$ represents the previous term instead of the next. Students who chose this option may need support in understanding how sequences represent patterns in mathematical relationships, with practice identifying these patterns in real-world situations.
Incorrect – 4	Students may have selected this option if they understood this sequence is best represented by a geometric sequence but used the reciprocal of the correct common ratio. Students who chose this option may need support in understanding how to find common ratios in geometric sequences.

Item Information

Item Code: TN648308 | Grade Level: Algebra II
Standard Code: A2.S.IC.A.1 | Position No: 21
Standard Text: Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
Calculator: Y
Correct Answer: 2,4,9

Consider the following studies:

Study 1: Researchers want to know if a certain type of plant grows larger in soil treated with a supplement compared to soil that is not treated.

Study 2: Researchers want to know what percent of people approve of the president's decisions.

Study 3: Researchers want to know the relationship between attending private or public school and attendance rates.

Mark the boxes in the table that match each study to the **most** appropriate study design.

	Survey	Experiment	Observational study
Study 1	O	O	O
Study 2	O	O	O
Study 3	O	O	O

Option	Rationale Text:	Survey	Experiment	Observational Study
Study 1	2, Students may have recognized that in order to control the testing environment, an experiment would be most appropriate.		Correct	
Study 2	4, Students may have recognized that since researchers want to know people’s opinions, a survey would be most appropriate.	Correct		
Study 3	9, Students may have recognized that a survey might not be as accurate as other methods, and that an experiment was not possible since researchers could not assign the children to public or private schools, so an observational study would be most appropriate.			Correct

Item Information

Item Code: TN946573 — Grade Level: Algebra II

Standard Code: A2.F.BF.A.1.a — Position No: 22

Standard Text: Determine an explicit expression, a recursive process, or steps for calculation from a context.

Calculator: Y

Correct Answer: C

A circle is cut in half. Then one of the halves is cut in half again. This repeats a number of times. The area of the original circle was 144π square centimeters.

Which function $f(x)$ represents the area of the smallest piece of the circle after x cuts?

A. $f(x) = 144\pi(0.5)x$

B. $f(x) = 144\pi - (0.5)x$

C. $f(x) = 144\pi(0.5)^x$

D. $f(x) = 144\pi - (0.5)^x$

Rationales	
Incorrect – 1	Students may have selected this option because they understood that this context was best represented by an exponential function, using the initial area of the circle and the common ratio but multiplying by x instead of raising the common ratio to the x power. Students who chose this option may need support in articulating real-world meaning for the components of exponential relationships, articulating the contribution of each variable to the real-world relationship.
Incorrect – 2	Students may have selected this option because they assumed this context was best represented by a linear function, using the initial area of the circle and mistaking the common ratio as a common difference. Students who chose this option may need support in understanding how to recognize linear, quadratic, and exponential functions from a context.
Correct – 3	This item requires that students understand how to determine an explicit expression from a context. Students may have recognized this context would best be represented by an exponential function. They may have used the initial area of the circle and the common ratio to determine the equation for this situation.
Incorrect – 4	Students may have selected this option because they understood that this context was best represented by an exponential function, using the initial area of the circle and the common ratio but using subtraction instead of multiplication since the figure is getting smaller. Students who chose this option may need support in articulating real-world meaning for the components of exponential relationships, articulating the contribution of each variable to the real-world relationship.

Additional Resources

- Information on Tennessee's Assessment Program
- Tennessee Academic Standards for Mathematics
- The eight Standards for Mathematical Practice
- Best for All Central
- Assessing Student Learning Reopening Toolkit
- Assessment Development LiveBinder Resource Site

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