pennsylvania
DEPARTMENT OF EDUCATION

The Pennsylvania System of School Assessment

Mathematics
Item and Scoring Sampler

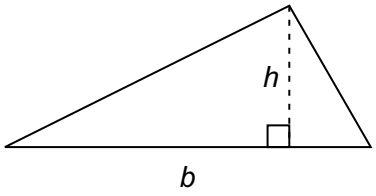
2024–2025
Grade 6

Pennsylvania Department of Education Bureau of Curriculum, Assessment and Instruction—August 2024

Grade 6 Formula Sheet

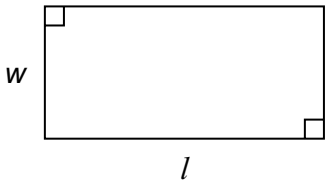
Formulas that you may need on this test are found below. 2024
You may refer back to this page at any time during the mathematics test. Grade 6

Triangle



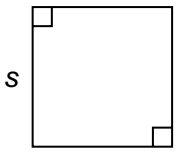
$A = \frac{1}{2} bh$

Rectangle



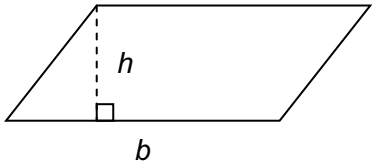
$A = lw$

Square



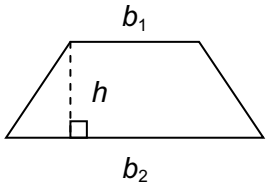
$A = s^2$

Parallelogram



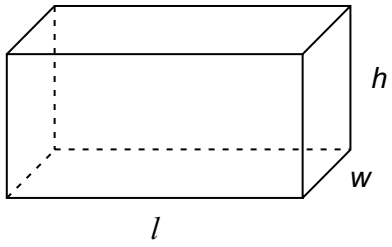
$A = bh$

Trapezoid



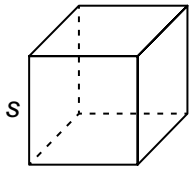
$A = \frac{1}{2} h(b_1 + b_2)$

Rectangular Prism



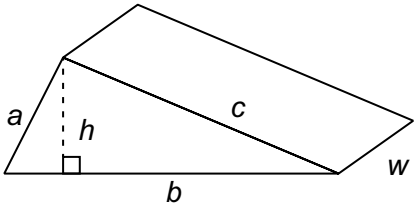
$V = lwh$ $SA = 2lw + 2lh + 2wh$

Cube



$V = s \cdot s \cdot s$ $SA = 6s^2$

Triangular Prism



$SA = bh + aw + bw + cw$

Question 1 in this Item and Scoring Sampler is to be solved without the use of a calculator.

Multiple-Choice Items

1. Divide: $\frac{4}{5} \div \frac{2}{3}$

Ⓐ $\frac{2}{15}$

Ⓑ $\frac{5}{6}$

Ⓒ $1\frac{1}{5}$

Ⓓ $4\frac{4}{5}$

Category	Item-Specific Information
Alignment	A-N.1.1.1
Answer Key	C
Depth of Knowledge	1
p-value A	26%
p-value B	13%
p-value C	56% (correct answer)
p-value D	5%
Option Annotations	A. divides the numerators (4 ÷ 2 = 2) and multiplies the denominators (5 · 3 = 15) B. identifies the reciprocal of $\frac{4}{5}$ as $\frac{5}{4}$ and then multiplies $\frac{5}{4}$ by $\frac{2}{3}$, resulting in $\frac{10}{12}$, and then simplifies by dividing the numerator and denominator by 2 C. Correct: identifies the reciprocal of $\frac{2}{3}$ as $\frac{3}{2}$, multiplies $\frac{4}{5}$ by $\frac{3}{2}$ by multiplying the numerators (4 · 3) and the denominators (5 · 2), resulting in the product $\frac{12}{10}$, then simplifies by dividing the numerator and denominator by 2, resulting in $\frac{6}{5}$, and then converts to a mixed number by dividing 6 by 5, using the whole-number quotient (1) as the whole-number part of the mixed number and the remainder (1) as the numerator of the fractional part of the mixed number D. multiplies the numerators (4 · 2 = 8) and divides the denominators $\left(5 \div 3 = \frac{5}{3}\right)$, simplifies the compound fraction $\frac{8}{\frac{5}{3}}$ by multiplying the numerator and denominator by 3, resulting in $\frac{24}{5}$, and then converts to a mixed number

A calculator is permitted for use in solving questions 2–17 in this Item and Scoring Sampler.

2. The prime factorizations of two numbers are shown below.

first number: $a \cdot a \cdot b \cdot b$

second number: $b \cdot b \cdot c$

Which expression represents a common factor of the two numbers?

Ⓐ $a \cdot c$

Ⓑ $b \cdot b$

Ⓒ $a \cdot b \cdot c$

Ⓓ $b \cdot b \cdot b \cdot b$

Category	Item-Specific Information
Alignment	A-N.2.2
Answer Key	B
Depth of Knowledge	2
p-value A	12%
p-value B	39% (correct answer)
p-value C	30%
p-value D	19%
Option Annotations	A. multiplies the two unique non-common prime factors B. Correct: identifies that both numbers contain only $b \cdot b$ as prime factors C. multiplies all three unique prime factors D. identifies that both numbers contain only $b \cdot b$ as prime factors but then multiplies these two expressions together

3. Kellen and Luke each have a bank account.

- Kellen's bank account increased in value last month.
- Luke's bank account decreased in value last month.

Each boy plots a point on the same number line to represent the amount by which the value of his bank account changed last month. Which statement about the boys' completed number line **must** be true?

Ⓐ The two points are the same distance from 0.

Ⓑ The two points are located on opposite sides of 0.

Ⓒ The point representing the decrease in Luke's bank account is at 0.

Ⓓ The point representing the increase in Kellen's bank account is located to the left of the point representing the decrease in Luke's bank account.

Category	Item-Specific Information
Alignment	A-N.3.1.3
Answer Key	B
Depth of Knowledge	2
p-value A	11%
p-value B	40% (correct answer)
p-value C	16%
p-value D	33%
Option Annotations	A. considers that the increase must be equal to the decrease even though the values of the increase and decrease are not provided B. Correct: recognizes that an increase represents a positive value, which is to the right of 0, and that a decrease represents a negative value, which is to the left of 0 C. considers a decrease to be similar to “no increase” D. considers that positive values are to the left of 0 and negative values are to the right of 0

4. The population growth of a town is described below.

- The population growth from 2005 to 2010 was -430 people.
- The population growth from 2010 to 2015 was 175 people.

Which statement about the population growth of the town is correct?

Ⓐ The population growth from 2005 to 2010 is less than the population growth from 2010 to 2015 because $-430 < 175$.

Ⓑ The population growth from 2005 to 2010 is less than the population growth from 2010 to 2015 because $175 < -430$.

Ⓒ The population growth from 2005 to 2010 is more than the population growth from 2010 to 2015 because $-430 > 175$.

Ⓓ The population growth from 2005 to 2010 is more than the population growth from 2010 to 2015 because $175 > -430$.

Category	Item-Specific Information
Alignment	A-N.3.2.1
Answer Key	A
Depth of Knowledge	2
p-value A	63% (correct answer)
p-value B	13%
p-value C	12%
p-value D	12%
Option Annotations	A. Correct: recognizes that a negative number ($^{-}430$) is always smaller than a positive number (175) B. recognizes that a decrease in population is less than an increase in population but then associates the increase, which is closer to 0, with the first population and the decrease, which is farther from 0, with the second population (i.e., reverses the inequality sign even though the initial statement is true) C. considers $^{-}430$ to be greater than 175 by not applying the negative sign and comparing 430 to 175 (i.e., reverses both the initial statement and the inequality sign) D. considers $^{-}430$ to be greater than 175 by not applying the negative sign and comparing 430 to 175 and then associates the increase, which is closer to 0, with the first population and the decrease, which is farther from 0, with the second population (i.e., reverses the initial statement even though the inequality is true)

5. A museum displays paintings and photographs. The ratio of paintings on display to photographs on display is $5:2$. Which statement about the number of paintings and the number of photographs on display at the museum **must** be true?

Ⓐ The museum has 3 more paintings on display than photographs on display.

Ⓑ The museum has 3 more photographs on display than paintings on display.

Ⓒ For every 2 paintings on display at the museum, there are 5 photographs on display.

Ⓓ For every 2 photographs on display at the museum, there are 5 paintings on display.

Category	Item-Specific Information
Alignment	A-R.1.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	25%
p-value B	10%
p-value C	17%
p-value D	48% (correct answer)
Option Annotations	A. either considers 5 and 2 to be the actual numbers OR considers that equivalent ratios are determined using addition/subtraction rather than multiplication/division B. reverses what the values in the ratio represent and either considers 5 and 2 to be the actual numbers OR considers that equivalent ratios are determined using addition/subtraction rather than multiplication/division C. recognizes that a ratio represents a multiplicative relationship (for every . . . , there are . . .) but then reverses what the values in the ratio represent D. Correct: recognizes that a ratio represents a multiplicative relationship (for every . . . , there are . . .) and then corresponds the first value in the ratio (5) to paintings and the second value in the ratio (2) to photographs

6. A computer lab charges customers to browse online. The table below shows the amount the computer lab charges a customer for different amounts of time spent browsing online.

Online Browsing Charges

Time Browsing (minutes)	30	45	75	120	210
Charge	$1.60	$2.40	$4.00	$6.40	?

Based on the table, how much does the computer lab charge a customer who spends 210 minutes browsing online?

Ⓐ $10.40

Ⓑ $11.20

Ⓒ $12.80

Ⓓ $14.40

Category	Item-Specific Information
Alignment	A-R.1.1.3
Answer Key	B
Depth of Knowledge	2
p-value A	27%
p-value B	47% (correct answer)
p-value C	15%
p-value D	11%
Option Annotations	A. adds the charges for 75 minutes and 120 minutes since the sum of the first two charges is the third charge and the sum of the second and third charges is the fourth charge but does not consider that 210 minutes is not the sum of 75 minutes and 120 minutes B. Correct: determines that an increase of 15 minutes is associated with an increase of $0.80 (e.g., by subtracting 30 from 45 and $1.60 from $2.40) and then either recognizes that the relation is proportional, divides 210 by 15, and multiplies the quotient (14) by $0.80 OR recognizes that there is an increase of 90 minutes from 120 minutes to 210 minutes, divides 90 by 15, multiplies the quotient (6) by $0.80, and adds the product ($4.80) to the charge for 120 minutes ($6.40) C. considers that the charges follow a doubling pattern and multiplies $6.40 by 2 D. finds the sum of all the charges in the table

7. Two groups of workers pick apples.

- The first group picks 30 bushels of apples in 3 hours.
- The second group picks 15 bushels of apples in 5 hours.

Based on these rates, what is the difference between the number of bushels each group picks in 4 hours?

Ⓐ 7

Ⓑ 15

Ⓒ 28

Ⓓ 60

Category	Item-Specific Information
Alignment	A-R.1.1.4
Answer Key	C
Depth of Knowledge	2
p-value A	18%
p-value B	29%
p-value C	44% (correct answer)
p-value D	9%
Option Annotations	A. finds the difference between the hourly rates (30 ÷ 3 = 10, 15 ÷ 5 = 3, 10 − 3 = 7) but does not multiply the difference by 4 hours B. subtracts 15 from 30 C. Correct: divides 30 by 3 to determine that the first group picks apples at a rate of 10 bushels per hour, divides 15 by 5 to determine that the second group picks apples at a rate of 3 bushels per hour, and then either multiplies the difference between the hourly rates (10 − 3 = 7) by 4 hours OR finds the difference between the number of bushels picked by subtracting the products of each hourly rate multiplied by 4 hours (10 · 4 = 40, 3 · 4 = 12, 40 − 12 = 28) D. subtracts 15 from 30 and then multiplies the difference (15) by 4

8. A student has two books. The first book weighs b pounds. The second book weighs $3\frac{7}{8}$ pounds. Together, the two books weigh $8\frac{1}{4}$ pounds. Which equation and solution represent this situation?

Ⓐ $2 \cdot b = 8\frac{1}{4}$

$b = 4\frac{1}{8}$ pounds

Ⓑ $b + 3\frac{7}{8} = 8\frac{1}{4}$

$b = 4\frac{3}{8}$ pounds

Ⓒ $b + 3\frac{7}{8} = 8\frac{1}{4}$

$b = 12\frac{1}{8}$ pounds

Ⓓ $2 \cdot b = 8\frac{1}{4}$

$b = 16\frac{1}{2}$ pounds

Category	Item-Specific Information
Alignment	B-E.2.1.3
Answer Key	B
Depth of Knowledge	2
p-value A	15%
p-value B	63% (correct answer)
p-value C	13%
p-value D	9%
Option Annotations	A. uses multiplication to set up an incorrect equation (i.e., considers that the books are equal in weight) but then solves the equation appropriately by dividing $8\frac{1}{4}$ by 2 B. Correct: identifies the key word "together," sets up the equation using addition, and then subtracts $3\frac{7}{8}$ from $8\frac{1}{4}$ to determine the missing value (*b*) in the equation C. identifies the key word "together" and sets up the equation using addition but then "solves" the equation by adding $3\frac{7}{8}$ to $8\frac{1}{4}$ D. uses multiplication to set up an incorrect equation (i.e., considers that the books are equal in weight) and then "solves" the equation by multiplying $8\frac{1}{4}$ by 2 rather than dividing by 2

9. Ms. Diaz rents a picnic area for a school party.

- She pays a fixed fee plus an additional $4 per person to rent the picnic area.
- Some students and 3 teachers, including Ms. Diaz, attend the school party.

The equation shown below represents this situation.

$$y = 60 + 4(3 + x)$$

What does the x in the equation **most likely** represent?

Ⓐ the number of students who attend the school party

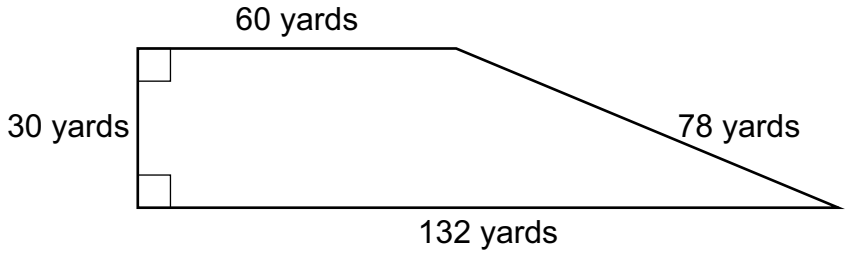
Ⓑ the total number of people who attend the school party

Ⓒ the fixed fee, in dollars, Ms. Diaz pays to rent the picnic area

Ⓓ the total amount of money, in dollars, Ms. Diaz pays to rent the picnic area

Category	Item-Specific Information
Alignment	B-E.3.1
Answer Key	A
Depth of Knowledge	2
p-value A	52% (correct answer)
p-value B	17%
p-value C	18%
p-value D	13%
Option Annotations	A. Correct: identifies the 4 as the dollar amount per person, which is being multiplied by the total number of people, which is represented by (3 + *x*), identifies the 3 as the number of teachers, and then concludes that the *x* must represent the number of students B. identifies what the (3 + *x*) represents (i.e., does not recognize that the teachers are represented by the 3 in the equation) C. identifies what the 60 represents D. identifies what the *y* represents

10. The figure below shows the shape of a park.



What is the area, in square yards, of the park?

Ⓐ 2,880

Ⓑ 3,240

Ⓒ 7,128

Ⓓ 7,488

Category	Item-Specific Information
Alignment	C-G.1.1.1
Answer Key	A
Depth of Knowledge	1
p-value A	47% (correct answer)
p-value B	27%
p-value C	14%
p-value D	12%
Option Annotations	A. Correct: recognizes that the left leg of the trapezoid represents the height of the trapezoid, applies the area formula for a trapezoid $\left[A = \frac{1}{2}h(b_1 + b_2)\right]$, using $h = 30$, $b_1 = 60$, and $b_2 = 132$ to set up the equation $A = \frac{1}{2}(30)(60 + 132)$, and then simplifies $A = \frac{1}{2}(30)(192) = 15(192) = 2{,}880$ square yards B. uses the non-parallel sides as the bases and the shorter side for the height to set up the area formula for a trapezoid as $A = \frac{1}{2}(60)(30 + 78)$ C. uses the non-parallel sides as the bases and the longer side for the height to set up the area formula for a trapezoid as $A = \frac{1}{2}(132)(30 + 78)$ D. uses the length of the non-perpendicular leg as the height to set up the area formula for a trapezoid as $A = \frac{1}{2}(78)(60 + 132)$

11. A rectangular box has a length of $1\frac{2}{3}$ feet, a width of $1\frac{1}{2}$ feet, and a height of $\frac{3}{5}$ foot. What is the volume, in cubic feet, of the rectangular box?

Ⓐ $1\frac{1}{2}$

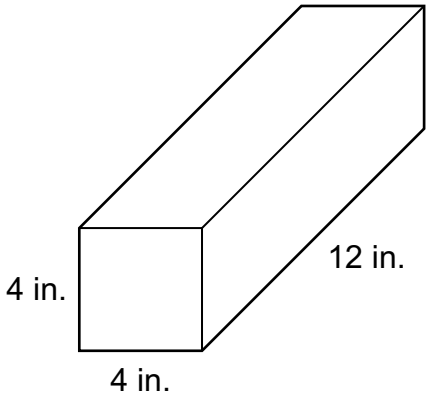
Ⓑ $2\frac{1}{5}$

Ⓒ $4\frac{2}{5}$

Ⓓ $4\frac{1}{2}$

Category	Item-Specific Information
Alignment	C-G.1.1.3
Answer Key	A
Depth of Knowledge	1
p-value A	54% (correct answer)
p-value B	19%
p-value C	18%
p-value D	9%
Option Annotations	A. Correct: applies the volume formula for a rectangular prism ($V = lwh$), using $l = 1\frac{2}{3}$, $w = 1\frac{1}{2}$, and $h = \frac{3}{5}$ to set up the equation $V = 1\frac{2}{3} \cdot 1\frac{1}{2} \cdot \frac{3}{5}$, and then simplifies $V = 1\frac{2}{3} \cdot 1\frac{1}{2} \cdot \frac{3}{5} = \frac{5}{3} \cdot \frac{3}{2} \cdot \frac{3}{5} = \frac{45}{30} = \frac{3}{2} = 1\frac{1}{2}$ cubic feet B. adds the two whole number parts (or multiplies incorrectly), resulting in 2 as the whole-number part, and then multiplies the fractions, resulting in $\frac{2}{3} \cdot \frac{1}{2} \cdot \frac{3}{5} = \frac{6}{30} = \frac{1}{5}$ as the fractional part C. attempts to find the surface area rather than the volume but does not multiply each product by 2, resulting in $1\frac{2}{3} \cdot 1\frac{1}{2} + 1\frac{2}{3} \cdot \frac{3}{5} + 1\frac{1}{2} \cdot \frac{3}{5} = \frac{5}{3} \cdot \frac{3}{2} + \frac{5}{3} \cdot \frac{3}{5} + \frac{3}{2} \cdot \frac{3}{5} = \frac{15}{6} + \frac{15}{15} + \frac{9}{10} = \frac{75}{30} + \frac{30}{30} + \frac{27}{30} = \frac{132}{30} = \frac{22}{5} = 4\frac{2}{5}$ D. applies the volume formula for a rectangular prism ($V = lwh$), using $l = \frac{5}{3}$, $w = \frac{3}{2}$, and $h = \frac{3}{5}$ to set up the equation $V = \frac{5}{3} \cdot \frac{3}{2} \cdot \frac{3}{5}$, but then multiplies the numerators and adds the denominators, resulting in $V = \frac{5 \cdot 3 \cdot 3}{3+2+5} = \frac{45}{10} = \frac{9}{2} = 4\frac{1}{2}$

12. A rectangular prism is shown below.



What is the surface area of the rectangular prism?

Ⓐ 64 square inches

Ⓑ 112 square inches

Ⓒ 128 square inches

Ⓓ 224 square inches

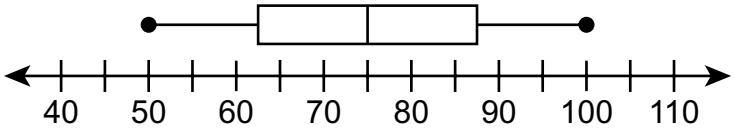
Category	Item-Specific Information
Alignment	C-G.1.1.6
Answer Key	D
Depth of Knowledge	1
p-value A	18%
p-value B	15%
p-value C	16%
p-value D	51% (correct answer)
Option Annotations	A. does not double each term in the surface area formula and does not include one of the $4 \cdot 12$ terms, resulting in $4 \cdot 12 + 4 \cdot 4 = 48 + 16 = 64$ B. does not double each term in the surface area formula, resulting in $4 \cdot 12 + 4 \cdot 4 + 12 \cdot 4 = 48 + 16 + 48 = 112$ C. does not include one of the $4 \cdot 12$ terms from the surface area formula, resulting in $2 \cdot 4 \cdot 12 + 2 \cdot 4 \cdot 4 = 96 + 32 = 128$ D. Correct: applies the surface area formula for a rectangular prism ($SA = 2lw + 2lh + 2wh$), using $l = 4$, $w = 12$, and $h = 4$ to set up the equation $SA = 2 \cdot 4 \cdot 12 + 2 \cdot 4 \cdot 4 + 2 \cdot 12 \cdot 4$, which can be simplified as $SA = 2 \cdot 4 \cdot 12 + 2 \cdot 4 \cdot 4 + 2 \cdot 12 \cdot 4 = 96 + 32 + 96 = 224$ square inches

13. The numbers of visitors at a museum during the last fourteen days are listed below.

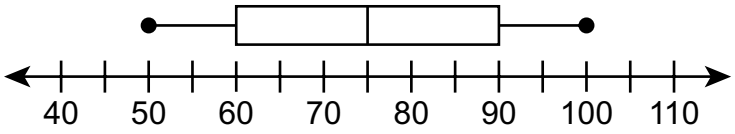
50 50 53 60 62 63 75 85 86 88 90 92 96 100

Which box-and-whisker plot represents the numbers of visitors at the museum during the last fourteen days?

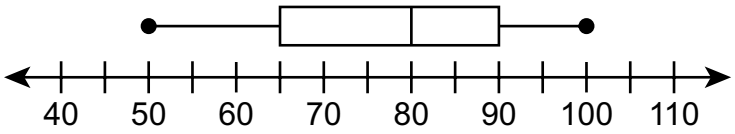
Ⓐ



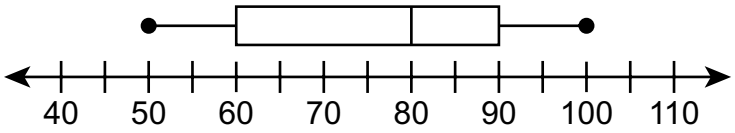
Ⓑ



Ⓒ



Ⓓ



Category	Item-Specific Information
Alignment	D-S.1.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	15%
p-value B	24%
p-value C	15%
p-value D	46% (correct answer)
Option Annotations	A. creates a symmetrical display based on the minimum value (50) and the maximum value (100), using the midpoint of 50 and 100 as the median value (50 + 100 = 150, 150 ÷ 2 = 75) and then using the midpoint of 50 and 75 (50 + 75 = 125, 125 ÷ 2 = 62.5) as the first-quartile value and the midpoint of 75 and 100 (75 + 100 = 175, 175 ÷ 2 = 87.5) as the third-quartile value B. uses the 7th value as the median value since 7 is half of 14 OR uses the mean rather than the median value OR creates a symmetrical display based on the first-quartile value (60) and the third-quartile value (90) C. identifies the median value as the average of the 7th and 8th numbers in the list (75 + 85 = 160, 160 ÷ 2 = 80) but then uses the midpoint between the minimum value and median value (50 + 80 = 130, 130 ÷ 2 = 65) as the first-quartile value and the midpoint between the median value and maximum value (80 + 100 = 180, 180 ÷ 2 = 90) as the third-quartile value D. Correct: recognizes that the fourteen numbers are ordered from least to greatest and then identifies the minimum value as the first number in the list (50), the first-quartile value as the 4th number in the list (60), the median value as the average of the 7th and 8th numbers in the list (75 + 85 = 160, 160 ÷ 2 = 80), the third-quartile value as the 11th number in the list (90), and the maximum value as the last number in the list (100)

14. The list below shows the number of text messages a teacher sent each day for 7 days.

14 16 18 22 23 23 24

Which expression shows how to determine the **mean absolute deviation** of the number of text messages the teacher sent?

Ⓐ $(-8 + -6 + -4 + 0 + 1 + 1 + 2) \div 7$

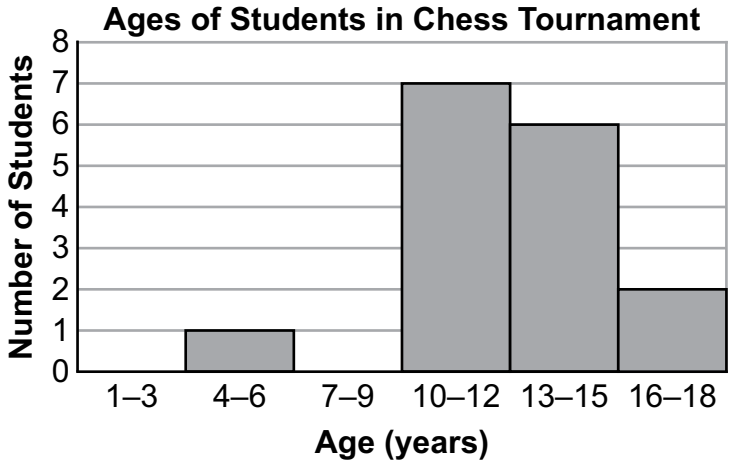
Ⓑ $(-6 + -4 + -2 + 2 + 3 + 3 + 4) \div 7$

Ⓒ $(6 + 4 + 2 + 2 + 3 + 3 + 4) \div 7$

Ⓓ $(8 + 6 + 4 + 0 + 1 + 1 + 2) \div 7$

Category	Item-Specific Information
Alignment	D-S.1.1.2
Answer Key	C
Depth of Knowledge	2
p-value A	13%
p-value B	17%
p-value C	45% (correct answer)
p-value D	25%
Option Annotations	A. uses the median value (22) rather than the mean value (20) and uses the differences between each data value and the median value (data value − median value) rather than the absolute differences between each data value and the median value ($\lvert\text{data value} - \text{median value}\rvert$) B. uses the differences between each data value and the mean value (data value − mean value) rather than the absolute differences between each data value and the mean value ($\lvert\text{data value} - \text{median value}\rvert$) C. Correct: determines the mean value by finding the total of the data values and dividing the sum by the number of data values (14 + 16 + 18 + 22 + 23 + 23 + 24 = 140, 140 ÷ 7 = 20) and then identifies the expression that represents the sum of the absolute differences between each data value and the mean value ($\lvert 14-20\rvert = \lvert -6\rvert = 6$, $\lvert 16-20\rvert = \lvert -4\rvert = 4$, $\lvert 18-20\rvert = \lvert -2\rvert = 2$, $\lvert 22-20\rvert = \lvert 2\rvert = 2$, $\lvert 23-20\rvert = \lvert 3\rvert = 3$, $\lvert 23-20\rvert = \lvert 3\rvert = 3$, $\lvert 24-20\rvert = \lvert 4\rvert = 4$) being divided by the number of data values (7) D. uses the median value (22) rather than the mean (20) when determining the absolute differences

15. The histogram below represents the ages, in years, of the sixteen students in a chess tournament.



Which statement about the ages of the students in the chess tournament is true?

Ⓐ The interval from 4 years to 6 years shows a gap in the data, and the interval from 10 years to 12 years shows the peak of the data.

Ⓑ The interval from 4 years to 6 years shows a gap in the data, and the interval from 16 years to 18 years shows the peak of the data.

Ⓒ The interval from 7 years to 9 years shows a gap in the data, and the interval from 10 years to 12 years shows the peak of the data.

Ⓓ The interval from 7 years to 9 years shows a gap in the data, and the interval from 16 years to 18 years shows the peak of the data.

Category	Item-Specific Information
Alignment	D-S.1.1.3
Answer Key	C
Depth of Knowledge	2
p-value A	29%
p-value B	8%
p-value C	57% (correct answer)
p-value D	6%
Option Annotations	A. identifies the interval showing the peak of the data but then selects the interval from 4 years to 6 years as the gap in the data since it is isolated from the other intervals B. selects the interval from 4 years to 6 years as the gap in the data since it is isolated from the other intervals and selects the interval with the greatest ages (16–18) as the “peak” C. Correct: recognizes that the interval from 7 years to 9 years represents a gap in the data since there is no bar for the 7–9 interval even though there are bars for the 4–6 and 10–12 intervals and recognizes that the interval from 10 years to 12 years represents the peak of the data since the bar for the 10–12 interval represents the greatest number of students D. identifies the interval from 7 years to 9 years as representing a gap in the data but then selects the interval with the greatest ages (16–18) as the “peak”

16. The high temperatures, in degrees Fahrenheit (°F), in a city for the first 10 days of August are shown below.

78 81 82 84 84 84 86 90 90 90

Which statement about the high temperatures is true?

Ⓐ The high temperatures are mostly clustered, making the mean value of 84.9°F an appropriate measure of center.

Ⓑ The high temperatures are mostly clustered, making the median value of 84.9°F an appropriate measure of center.

Ⓒ The high temperatures are skewed to the right, making the mean value of 84.9°F an appropriate measure of center.

Ⓓ The high temperatures are skewed to the right, making the median value of 84.9°F an appropriate measure of center.

Category	Item-Specific Information
Alignment	D-S.1.1.4
Answer Key	A
Depth of Knowledge	2
p-value A	38% (correct answer)
p-value B	22%
p-value C	24%
p-value D	16%
Option Annotations	A. Correct: recognizes that the data distribution is mostly clustered since there are no outliers (i.e., all the data are relatively close to the mean and median values), which means both the mean and the median are appropriate measures of center, and so identifies the mean value (78 + 81 + 82 + 84 + 84 + 84 + 86 + 90 + 90 + 90 = 849, 849 ÷ 10 = 84.9) as an appropriate measure of center B. recognizes that the data distribution is mostly clustered since there are no outliers (i.e., all the data are relatively close to the mean and median values), which means both the mean and the median are appropriate measures of center, but uses the value for the mean (84.9) rather than for the median (84) even though the median was identified as the appropriate measure of center C. thinks the data distribution is skewed to the right because of the three 90-degree temperatures and does not recognize that the mean value is not an appropriate measure of center for skewed data D. thinks that the data distribution is skewed to the right because of the three 90-degree temperatures and uses the value for the mean (84.9) rather than for the median (84) even though the median would be an appropriate measure of center for skewed data

Open-Ended Item

17. A local theater is selling tickets to several performances.

The local theater is offering a discount for purchasing 4 tickets to a performance. When 4 tickets with the same price are purchased, a $6 discount is applied. The expression shown below can be used to determine the total amount of money, in dollars, a customer is charged when purchasing 4 tickets with the same price.

$$4n - 6$$

A. What is the total amount of money, in dollars, a customer is charged when $n = 30$?

B. Using the information from **part A**, explain what the term $4n$ represents in the context of the situation.

Go to the next page to finish question 17.

GO ON

17. ***Continued.*** Please refer to the previous page for task explanation.

The ticket price for a performance on Thursday evening is t dollars. The ticket price for a performance on Friday evening is $35, which is $12 more than it is on Thursday evening. The equation shown below represents this situation.

$$t + 12 = 35$$

C. What is the ticket price (t), in dollars, for a performance on Thursday evening?

With the discount applied to some of the tickets purchased, the average ticket price is p dollars. The expression shown below can be used to determine the amount of money, in dollars, the local theater expects to earn based on the average ticket price.

$$250p - 5p^2 - 2{,}000$$

D. Explain why the local theater should **not** set the average ticket price to less than $10 or to more than $40.

After you have finished your work, close this booklet so your teacher will know you are finished.

Item-Specific Scoring Guideline

#17 Item Information

Category	Item-Specific Information
Alignment	B-E.1 B-E.2.1.3
Depth of Knowledge	3
Mean Score	1.78

Assessment Anchor this item will be reported under:

M06.B-E.1 Apply and extend previous understandings of arithmetic to numerical and algebraic expressions.

Specific Anchor Descriptor addressed by this item:

M06.B-E.1.1 Identify, write, and evaluate numerical and algebraic expressions.

M06.B-E.2.1 Create, solve, and interpret one-variable equations or inequalities in real-world and mathematical problems.

Item-Specific Scoring Guideline

Score	In this item, the student . . .
4	Demonstrates a thorough understanding of how to apply and extend previous understandings of arithmetic to numerical and algebraic expressions by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of how to apply and extend previous understandings of arithmetic to numerical and algebraic expressions by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of how to apply and extend previous understandings of arithmetic to numerical and algebraic expressions by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of how to apply and extend previous understandings of arithmetic to numerical and algebraic expressions.
0	The response has no correct answer and insufficient evidence to demonstrate any understanding of the mathematical concepts and procedures as required by the task. Response may show only information copied from the question.

Top-Scoring Student Response and Training Notes

Score	Description
4	Student earns 4 points.
3	Student earns 3.0–3.5 points.
2	Student earns 2.0–2.5 points.
1	Student earns 0.5–1.5 points. OR Student demonstrates minimal understanding of how to apply and extend previous understandings of arithmetic to numerical and algebraic expressions.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

Top-Scoring Response

Part A (1 point):

1 point for correct answer

What?
($)114

Part B (1 point):

1 point for correct and complete response

OR 1/2 point for correct but incomplete response

What?
Sample Response: The full price of the 4 tickets. **OR** The price of the 4 tickets without (before) the discount. **OR equivalent**

Part C (1 point):

1 point for correct answer

What?
($)23

Part D (1 point):

1 point for correct and complete explanation

OR 1/2 point for correct but incomplete explanation

Why?

Sample Explanation:

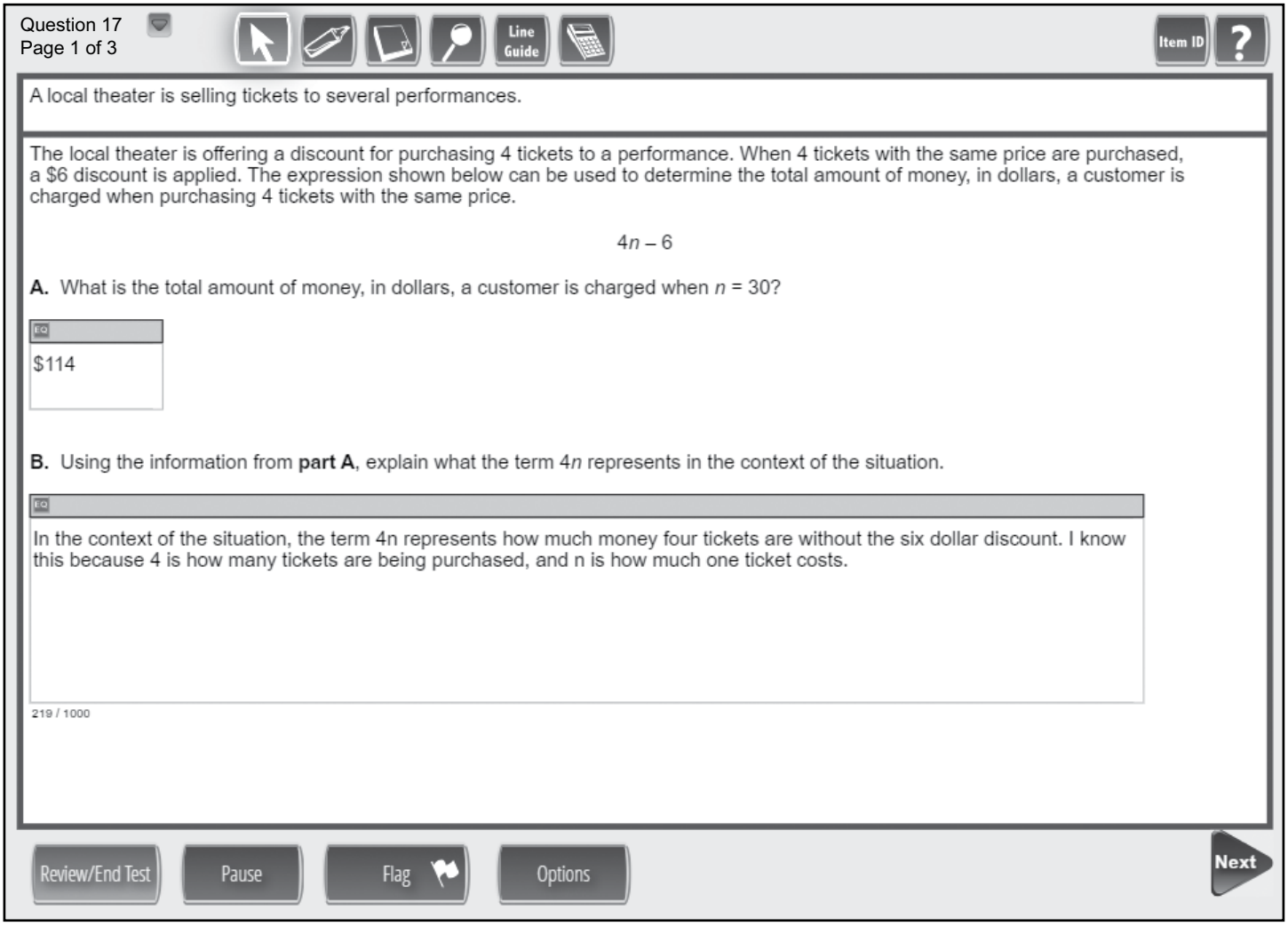
When substituting a value less than 10 or a value greater than 40 into the expression for p, the amount of money the local theater would expect to earn is a negative amount. This means the company would lose money with these average ticket prices. So the local theater should not set the average ticket price to less than $10 or to more than $40.

OR equivalent

STUDENT RESPONSE

Computer Response Score: 4 points

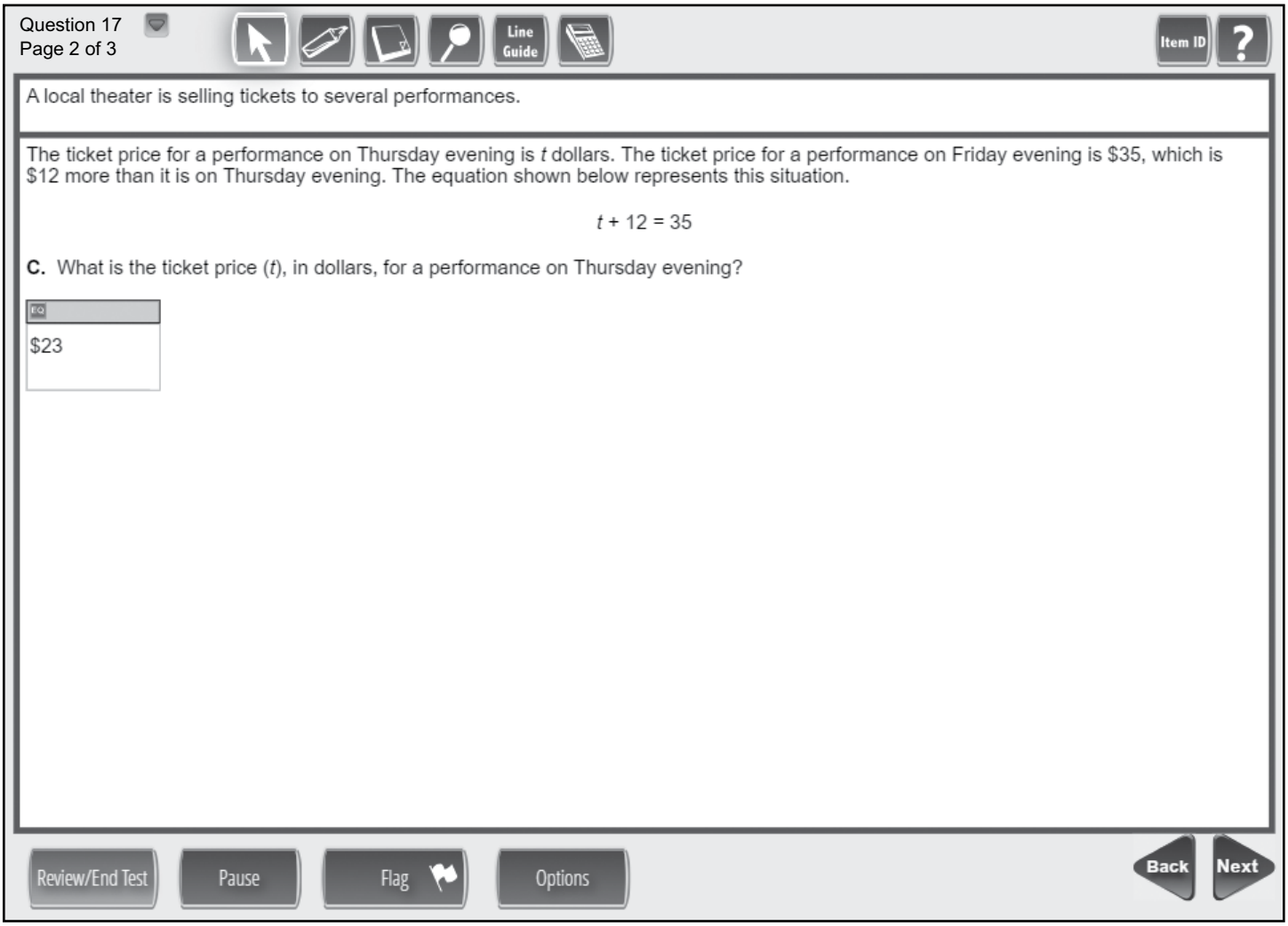
PARTS A and B



Part A: The student provided the correct answer (*$114*). While support is not required for Part A, the student likely substituted 30 into the expression for *n* and solved 4(30) − 6 = 120 − 6 = 114. [1 point]

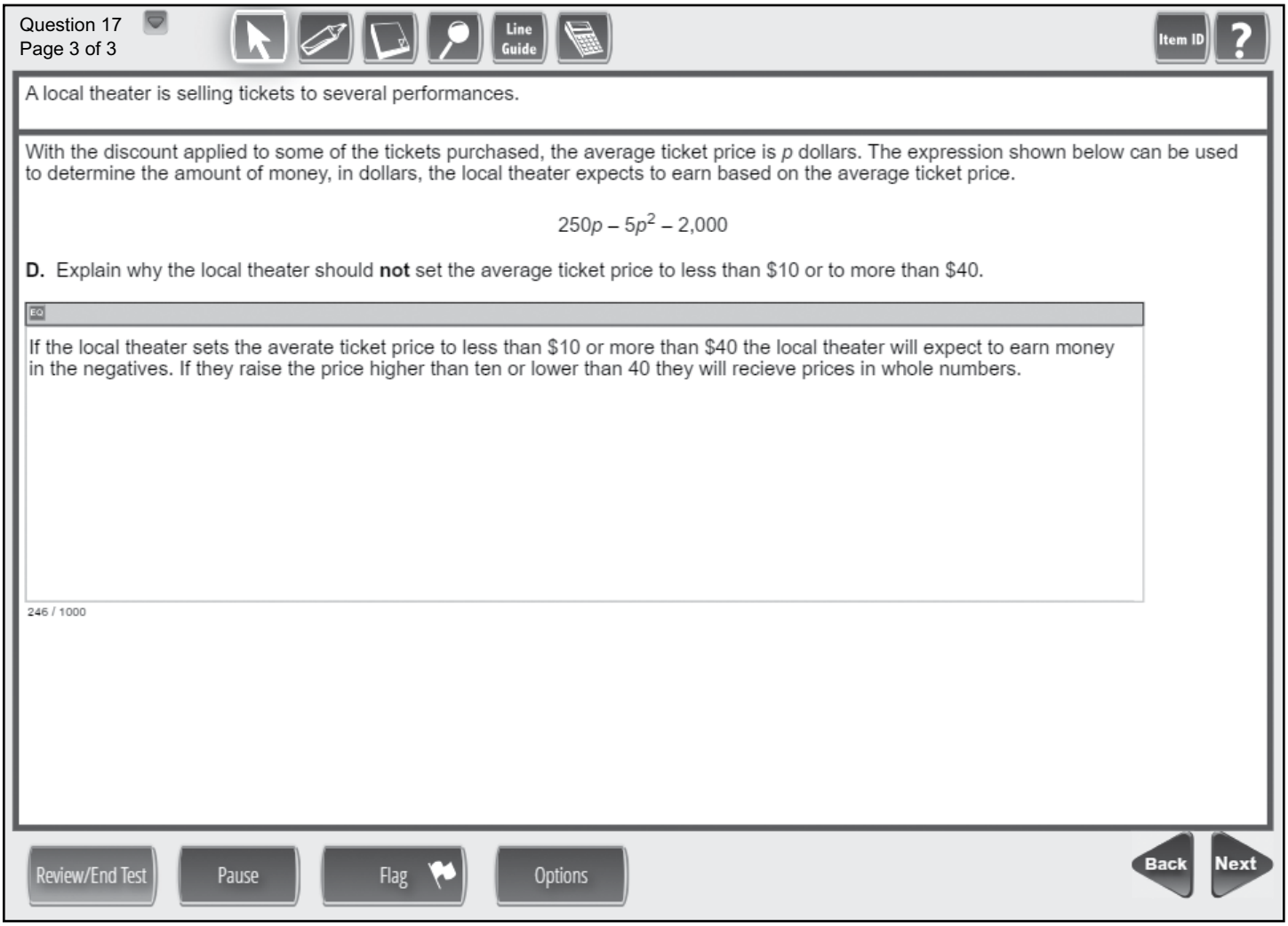
Part B: The student provided two correct and complete responses explaining what the term 4*n* represents (*4n represents how much money four tickets are without the six dollar discount* AND *4 is how many tickets are being purchased, and n is how much one ticket costs*). Either response is considered correct and complete, though only one is necessary for credit. [1 point]

PART C



Part C: The student provided the correct answer (*$23*). While support is not required for Part C, the student likely solved the given equation for *t* by subtracting 12 from both sides of the equation, resulting in *t* = 23. [1 point]

PART D



Part D: The student provided a correct and complete explanation as to why the local theater should not set the average ticket price to less than $10 or to more than $40 (*the local theater will expect to earn money in the negatives*). [1 point]

STUDENT RESPONSE

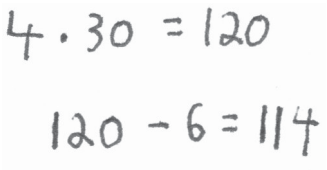
Response Score: 3 points

17. A local theater is selling tickets to several performances.

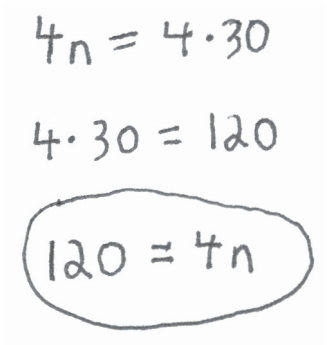
The local theater is offering a discount for purchasing 4 tickets to a performance. When 4 tickets with the same price are purchased, a $6 discount is applied. The expression shown below can be used to determine the total amount of money, in dollars, a customer is charged when purchasing 4 tickets with the same price.

$$4n - 6$$

A. What is the total amount of money, in dollars, a customer is charged when $n = 30$?



B. Using the information from **part A**, explain what the term $4n$ represents in the context of the situation.



Go to the next page to finish question 17.

GO ON

Part A: The student provided the correct answer (*114*). The work shown is correct, though not necessary for credit. The student multiplied 4 by 30 (since $n = 30$), resulting in a product of 120, and then subtracted 6 from 120, resulting in a difference of 114. [1 point]

Part B: The student provided an incorrect response ($4n = 4 \cdot 30, 4 \cdot 30 = 120, 120 = 4n$) that does not explain what the term $4n$ represents. The student instead showed how to determine the numerical value of $4n$ by using $n = 30$ from Part A. [0 points]

17. ***Continued.*** Please refer to the previous page for task explanation.

The ticket price for a performance on Thursday evening is t dollars. The ticket price for a performance on Friday evening is $35, which is $12 more than it is on Thursday evening. The equation shown below represents this situation.

$$t + 12 = 35$$

C. What is the ticket price (t), in dollars, for a performance on Thursday evening?

$t + 12 = 35$
$35 \div 12 = 23$
$t = 23$

With the discount applied to some of the tickets purchased, the average ticket price is p dollars. The expression shown below can be used to determine the amount of money, in dollars, the local theater expects to earn based on the average ticket price.

$$250p - 5p^2 - 2{,}000$$

D. Explain why the local theater should **not** set the average ticket price to less than $10 or to more than $40.

because they will lose money

After you have finished your work, close this booklet so your teacher will know you are finished.

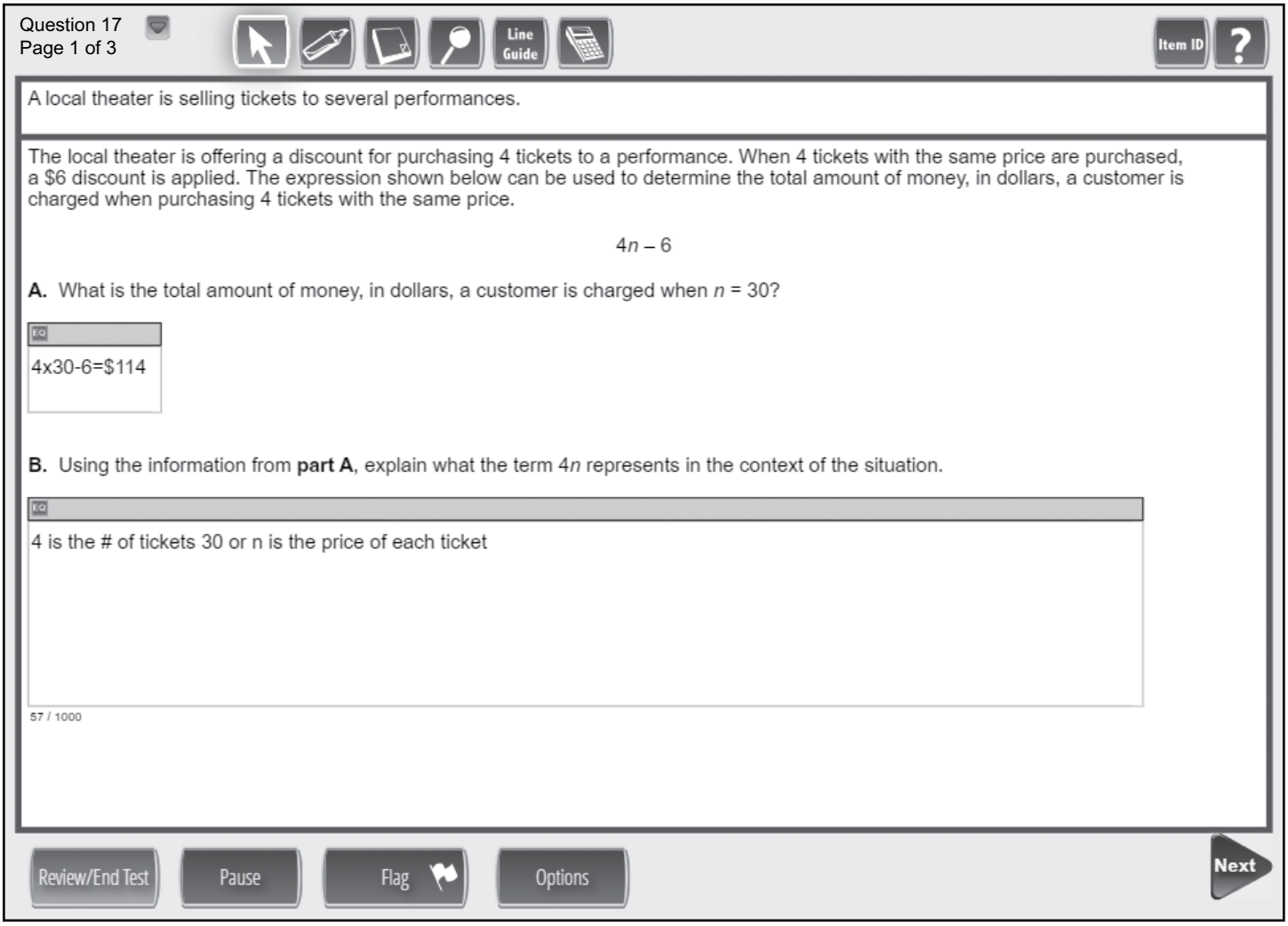
Part C: The student provided the correct answer ($t = 23$). While support (work or explanation) is not necessary for credit, the student provided some work. The student solved the given equation for t by subtracting 12 from both sides. While the student wrote $35 \div 12 = 23$, the student correctly subtracted to find the correct answer. Because the student performed the correct operation and arrived at the correct answer, the use of a division symbol (÷) rather than a subtraction symbol (−) is considered a blemish and does not affect the student's final score. [1 point]

Part D: The student provided a correct and complete explanation as to why the local theater should not set the average ticket price to less than $10 or to more than $40 (*because they will lose money*). [1 point]

STUDENT RESPONSE

Computer Response Score: 2 points

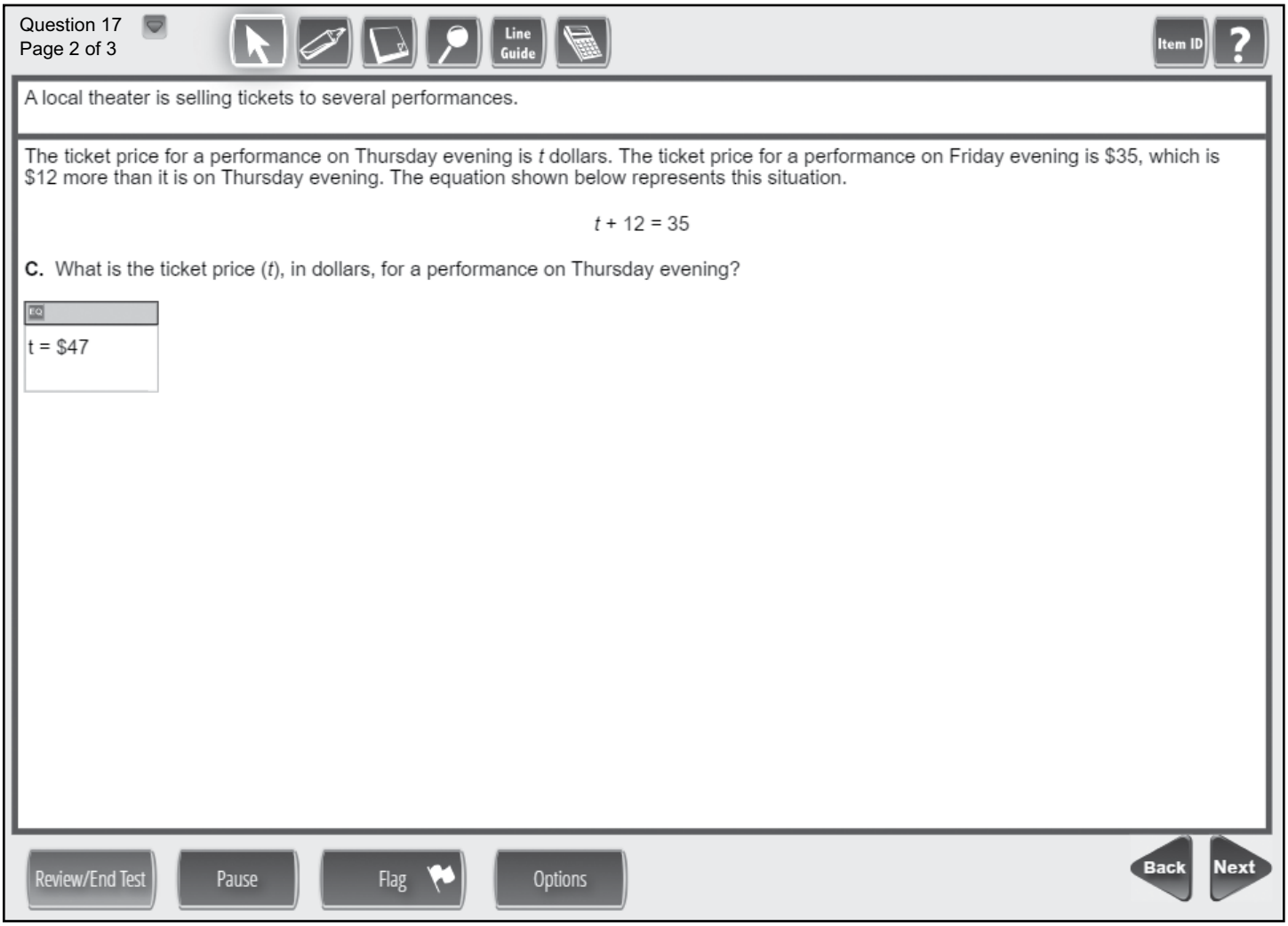
PARTS A and B



Part A: The student provided the correct answer (*$114*). The work shown is correct, though not necessary for credit. The student substituted 30 into the expression for *n* and evaluated the expression (*4x30-6=$114*). [1 point]

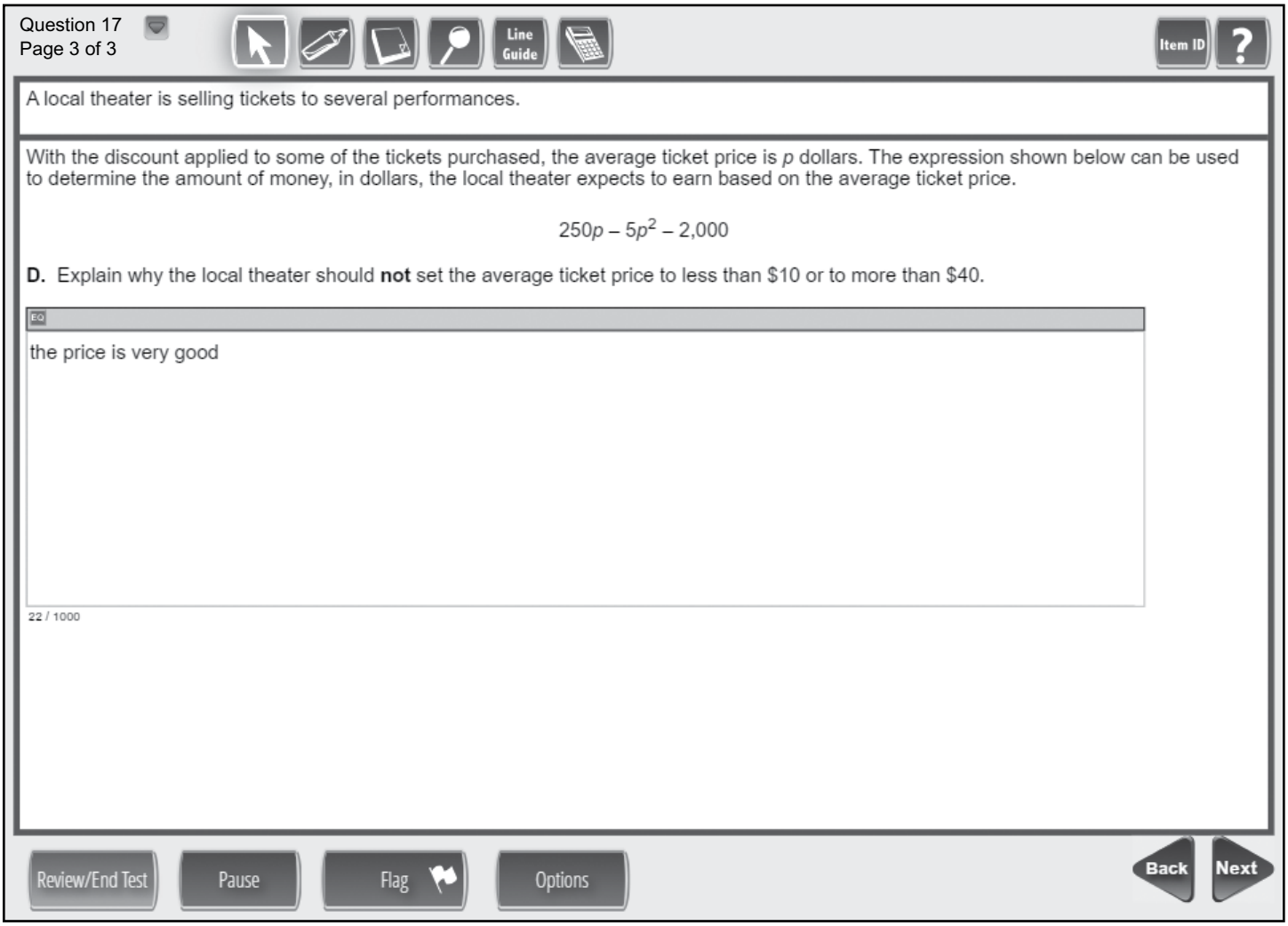
Part B: The student provided a correct and complete response explaining what the term 4*n* represents by explaining what the 4 and the *n* each represent (*4 is the # of tickets . . . n is the price of each ticket*). [1 point]

PART C



Part C: The student provided an incorrect answer (*t = $47*). No support (work or explanation) is required, so it is unclear where an error was made. The student likely added 12 to 35 rather than subtracting 12 from 35. [0 points]

PART D



Part D: The student provided an incorrect explanation (*the price is very good*) that does not explain why the local theater should not set the average ticket price to less than $10 or to more than $40. [0 points]

STUDENT RESPONSE

Response Score: 1 point

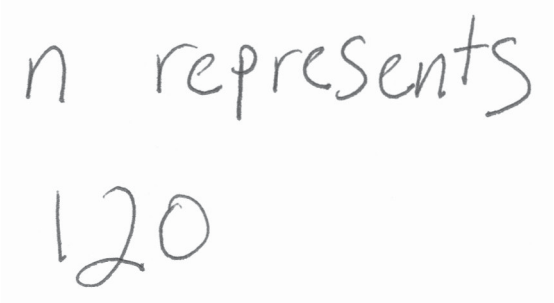
17. A local theater is selling tickets to several performances.

The local theater is offering a discount for purchasing 4 tickets to a performance. When 4 tickets with the same price are purchased, a $6 discount is applied. The expression shown below can be used to determine the total amount of money, in dollars, a customer is charged when purchasing 4 tickets with the same price.

$$4n - 6$$

A. What is the total amount of money, in dollars, a customer is charged when $n = 30$?

B. Using the information from **part A**, explain what the term $4n$ represents in the context of the situation.



Go to the next page to finish question 17.

GO ON

Part A: The student provided an incorrect answer (*120*). Though support (work or explanation) is not required, the work shows that the student determined the value of $4n$ from repeated addition ($30 + 30 + 30 + 30 = 120$) but did not subtract 6 from the total. [0 points]

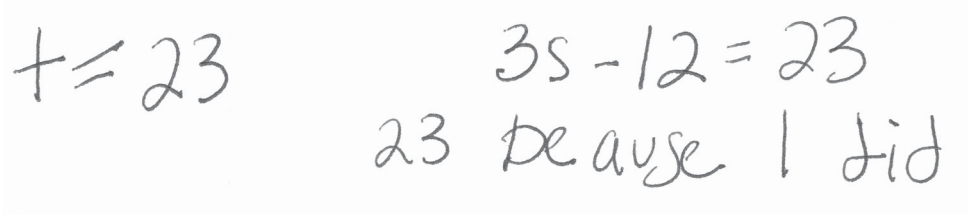
Part B: The student provided an incorrect response (*n represents 120*) that does not explain what the term $4n$ represents. The student instead provided the numerical value of $4n$ by using $n = 30$ from Part A and then stated that 120 is what n represents rather than what $4n$ represents. [0 points]

17. ***Continued.*** Please refer to the previous page for task explanation.

The ticket price for a performance on Thursday evening is t dollars. The ticket price for a performance on Friday evening is $35, which is $12 more than it is on Thursday evening. The equation shown below represents this situation.

$$t + 12 = 35$$

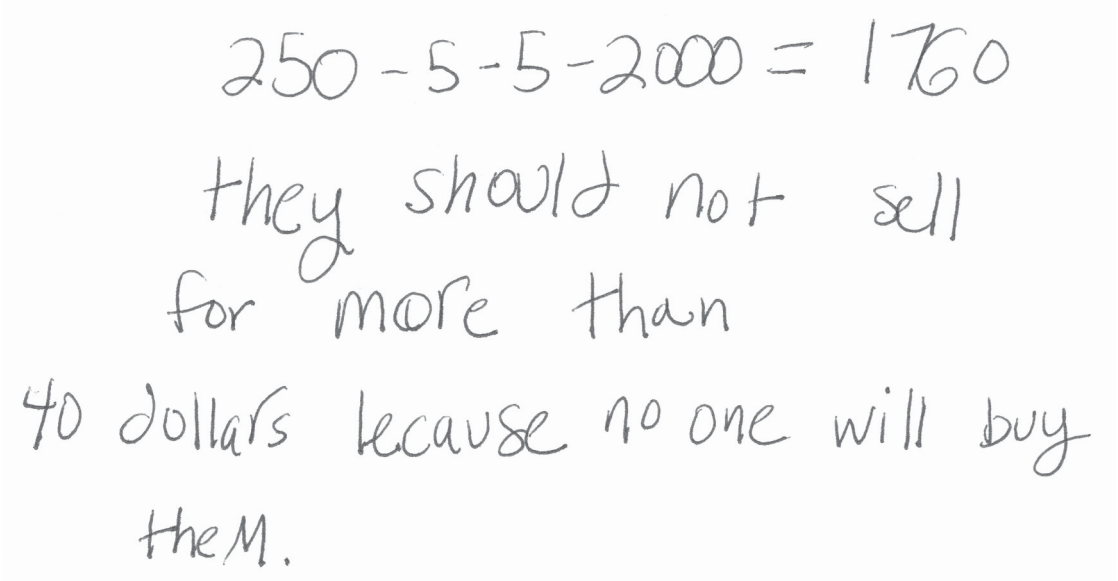
C. What is the ticket price (t), in dollars, for a performance on Thursday evening?



With the discount applied to some of the tickets purchased, the average ticket price is p dollars. The expression shown below can be used to determine the amount of money, in dollars, the local theater expects to earn based on the average ticket price.

$$250p - 5p^2 - 2{,}000$$

D. Explain why the local theater should **not** set the average ticket price to less than $10 or to more than $40.



After you have finished your work, close this booklet so your teacher will know you are finished.

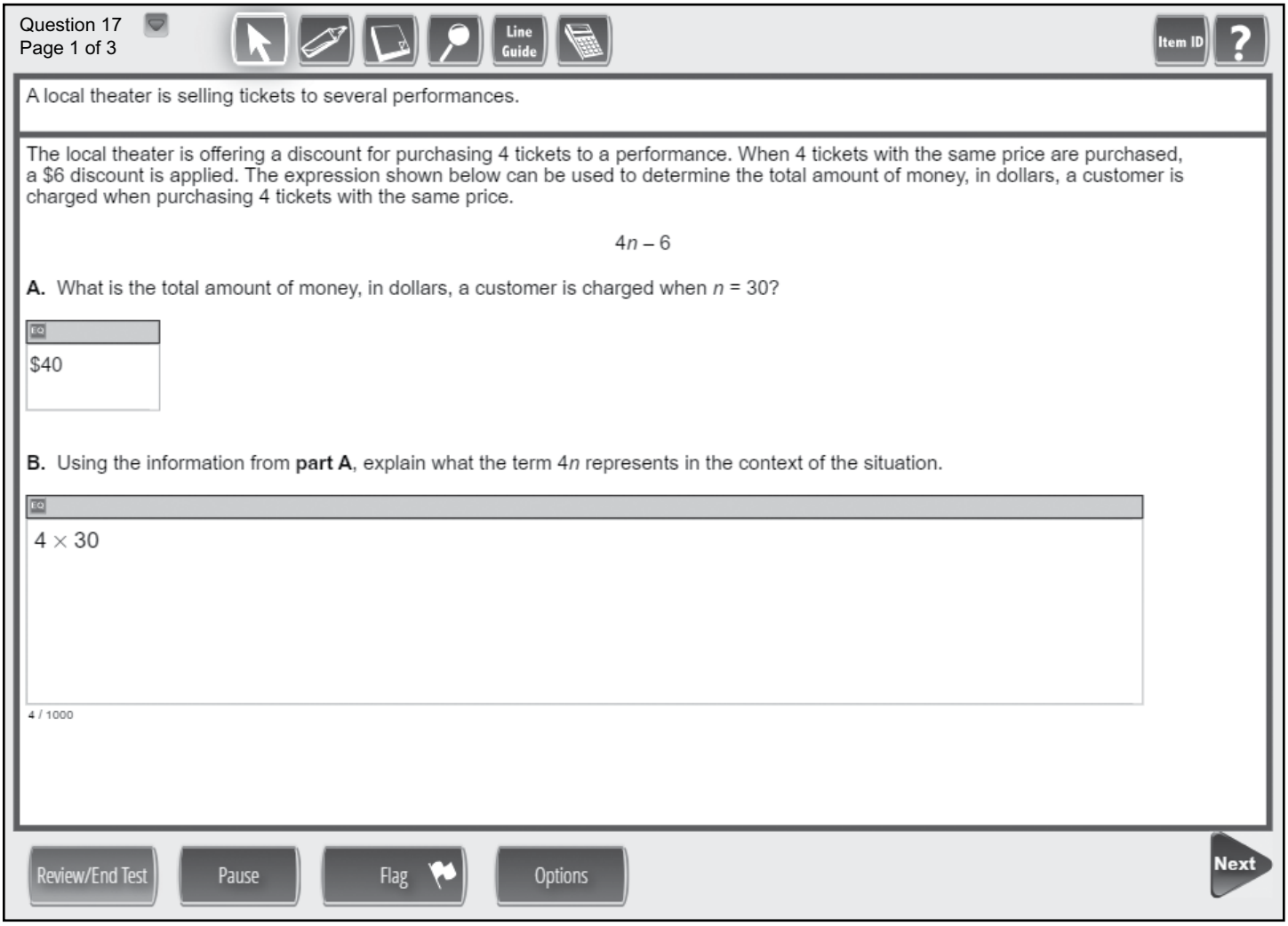
Part C: The student provided the correct answer ($t = 23$). The work shown is correct, though not necessary for credit ($35 - 12 = 23$). [1 point]

Part D: The student provided an incorrect explanation (*because no one will buy them*) that does not explain why the local theater should not set the average ticket price to less than $10 or to more than $40. [0 points]

STUDENT RESPONSE

Computer Response Score: 0 points

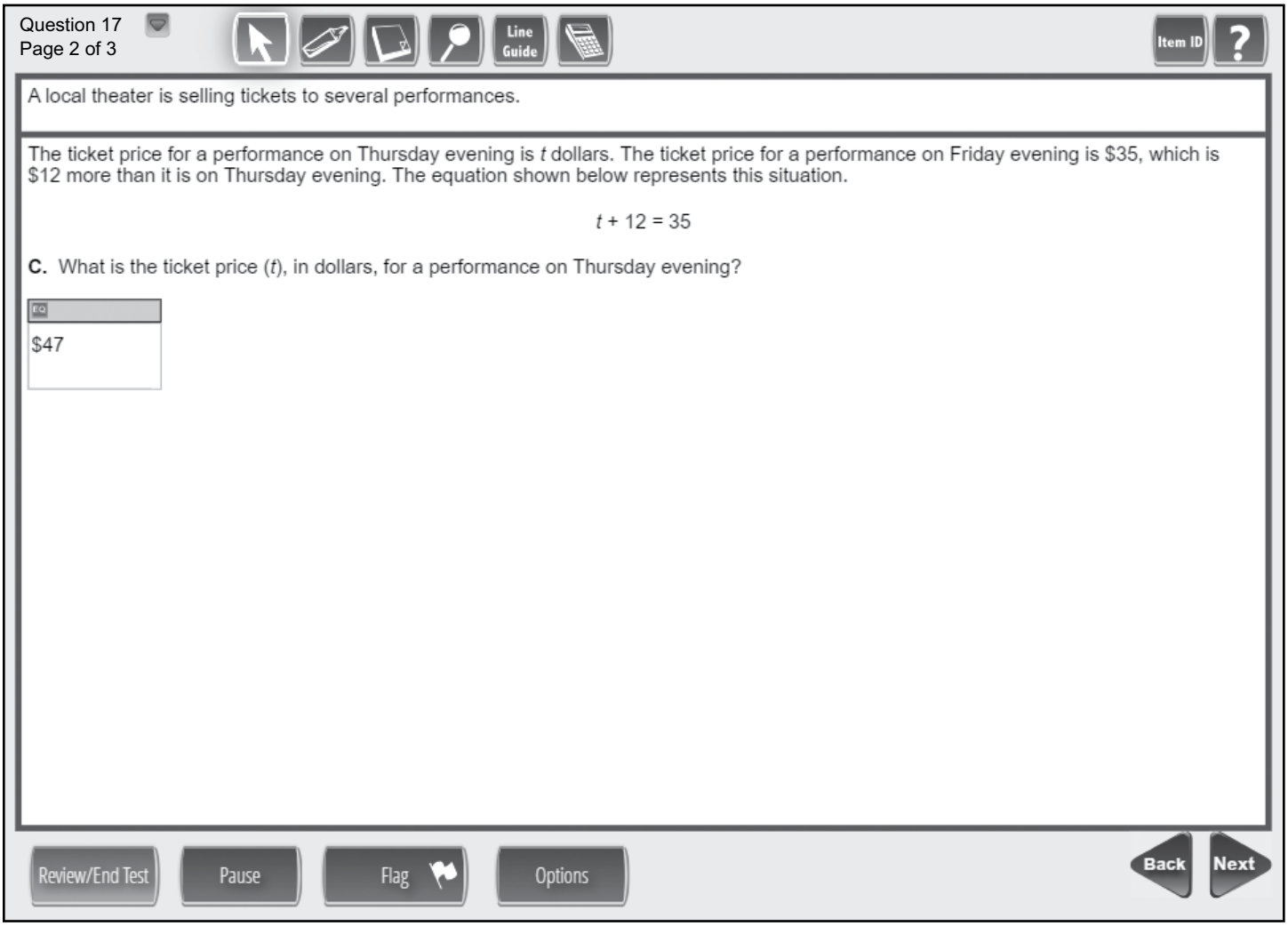
PARTS A and B



Part A: The student provided an incorrect answer (*$40*). No support (work or explanation) is required, so it is unclear where an error was made. The student may have substituted the 30 in for *n* but then added the 4 and the 6 to 30, resulting in a sum of 40, rather than multiplying 30 by 4 and then subtracting 6. [0 points]

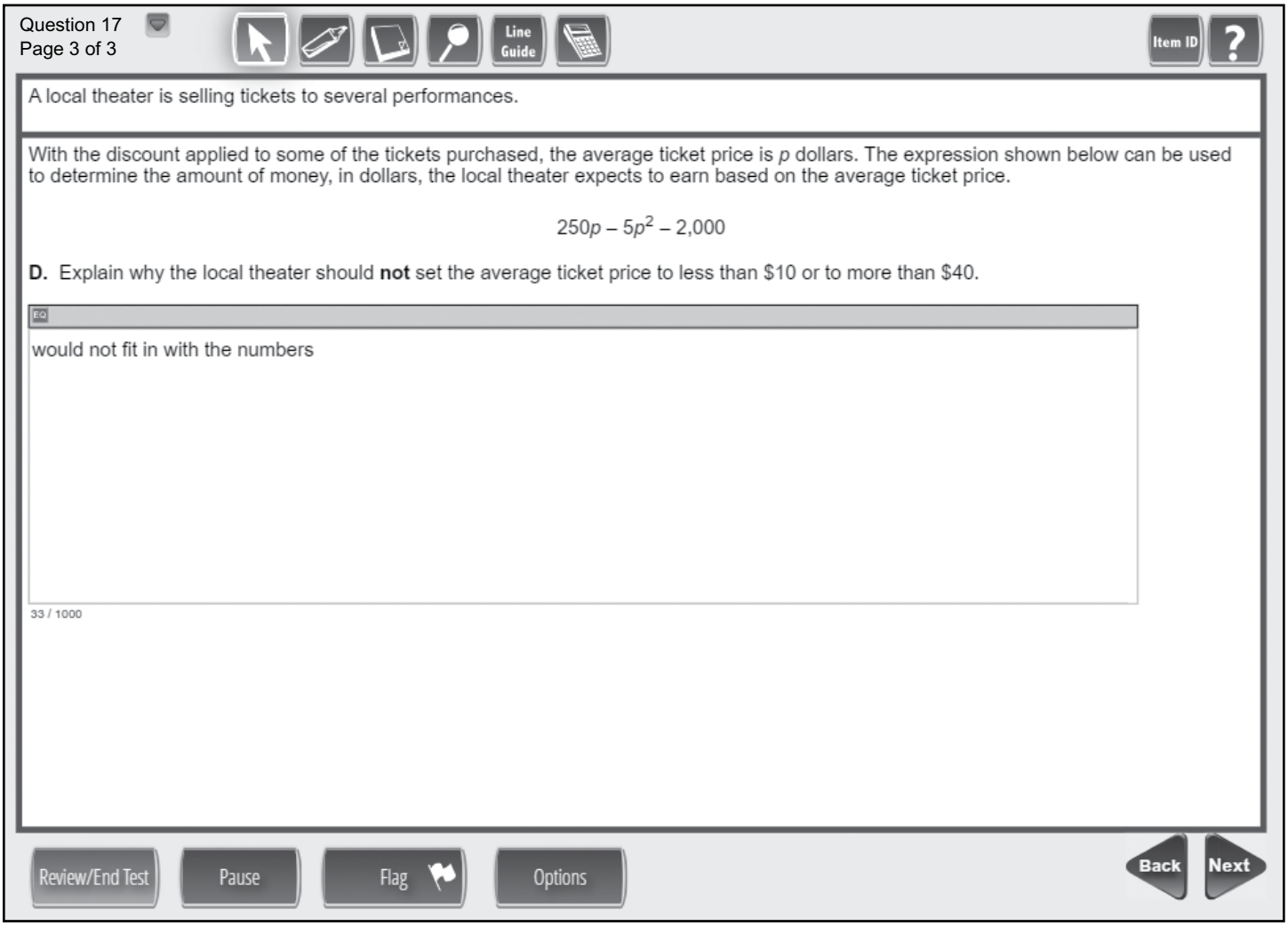
Part B: The student provided an incorrect response (*4 × 30*) that does not explain what the term 4*n* represents. The student instead provided a multiplication expression for 4*n* by using *n* = 30 from Part A. [0 points]

PART C



Part C: The student provided an incorrect answer (*$47*). No support (work or explanation) is required, so it is unclear where an error was made. The student likely added 12 to 35 rather than subtracting 12 from 35. [0 points]

PART D



Part D: The student provided an incorrect explanation (*would not fit in with the numbers*) that does not explain why the local theater should not set the average ticket price to less than $10 or to more than $40. [0 points]

Mathematics—Summary Data

Multiple-Choice

An asterisk (*) indicates the key.

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-value A	*p*-value B	*p*-value C	*p*-value D
1	A-N.1.1.1	C	1	26%	13%	56%*	5%
2	A-N.2.2	B	2	12%	39%*	30%	19%
3	A-N.3.1.3	B	2	11%	40%*	16%	33%
4	A-N.3.2.1	A	2	63%*	13%	12%	12%
5	A-R.1.1.1	D	2	25%	10%	17%	48%*
6	A-R.1.1.3	B	2	27%	47%*	15%	11%
7	A-R.1.1.4	C	2	18%	29%	44%*	9%
8	B-E.2.1.3	B	2	15%	63%*	13%	9%
9	B-E.3.1	A	2	52%*	17%	18%	13%
10	C-G.1.1.1	A	1	47%*	27%	14%	12%
11	C-G.1.1.3	A	1	54%*	19%	18%	9%
12	C-G.1.1.6	D	1	18%	15%	16%	51%*
13	D-S.1.1.1	D	2	15%	24%	15%	46%*
14	D-S.1.1.2	C	2	13%	17%	45%*	25%
15	D-S.1.1.3	C	2	29%	8%	57%*	6%
16	D-S.1.1.4	A	2	38%*	22%	24%	16%

Open-Ended

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	B-E.1 B-E.2.1.3	4	3	1.78