New England Common Assessment Program

Released Items Support Materials 2008

Grade 11 Mathematics

N&O 10.2 Demonstrates understanding of the relative magnitude of real numbers by solving problems involving ordering or comparing rational numbers, common irrational numbers (e.g., $\sqrt{2}$, π), rational bases with integer exponents, square roots, absolute values, integers, or numbers represented in scientific notation using number lines or equality and inequality symbols.

1 If $x^2 < y^2$, which inequality **must** be true?

A. $x < y$

B. $x^3 < y^3$

C. $|x| < |y|$

D. $\frac{1}{x} < \frac{1}{y}$

N&O 10.4 Accurately solves problems involving rational numbers within mathematics, across content strands, disciplines or contexts (with emphasis on, but not limited to, proportions, percents, ratios, and rates).

2 Jesse travels 15.0 miles by boat in 2.5 hours.
What is his average speed in knots?
[1 knot ≈ 1.2 miles per hour]

A. 5.0 knots

B. 6.0 knots

C. 7.2 knots

D. 12.5 knots

G&M 10.2 Makes and defends conjectures, constructs geometric arguments, uses geometric properties, or uses theorems to solve problems involving angles, lines, polygons, circles, or right triangle ratios (sine, cosine, tangent) within mathematics or across disciplines or contexts (e.g., Pythagorean Theorem, Triangle Inequality Theorem).

3 Look at this statement.

> Any transformation of triangle *LMN* on a coordinate grid results in a congruent image.

Which transformation represents a **counterexample** to this statement?

A. Triangle *LMN* is reflected about the line $y = -5$.

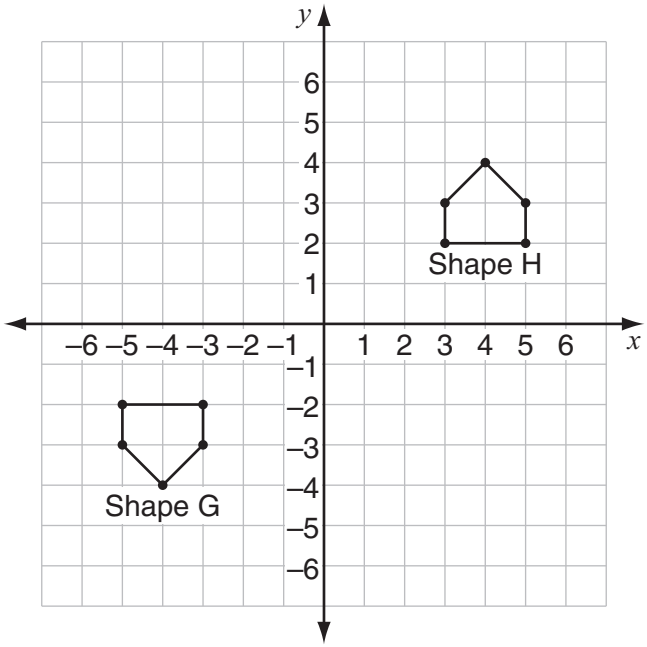
B. Triangle *LMN* is translated 4 units left and 2 units down.

C. Triangle *LMN* is rotated 90° counterclockwise about the point (0, 0).

D. Triangle *LMN* is dilated with a scale factor of 2 about the point (0, 0).

G&M 10.4 Applies the concepts of congruency by solving problems on or off a coordinate plane involving reflections, translations, or rotations; or solves problems using congruency involving problems within mathematics or across disciplines or contexts.

4 Look at Shape G and Shape H on this grid.



Which transformations will show that Shape G is congruent to Shape H?

A. Translate Shape G right 8 units and then reflect it across the *y*-axis.

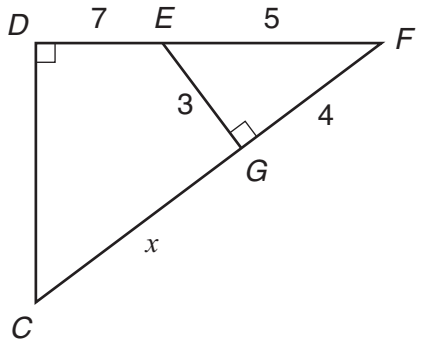
B. Translate Shape G right 6 units and then reflect it across the *x*-axis.

C. Translate Shape G right 8 units and then reflect it across the *x*-axis.

D. Translate Shape G up 6 units and then reflect it across the *y*-axis.

G&M 10.5 Applies concepts of similarity by solving problems within mathematics or across disciplines or contexts.

5 Look at these triangles.



not drawn to scale

Triangle CDF is similar to triangle EGF ($\Delta CDF \sim \Delta EGF$). What is the value of x?

A. 15

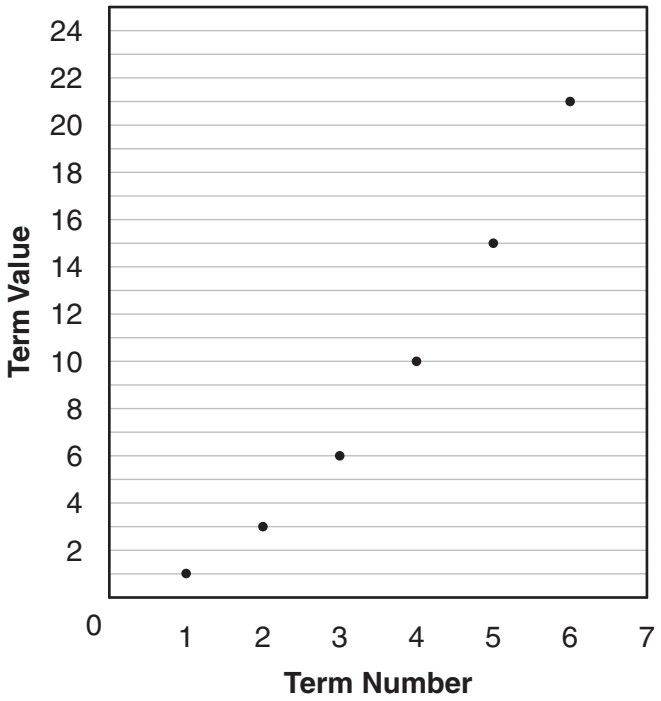
B. 11

C. 9

D. 6

F&A 10.1 Identifies, extends, and generalizes a variety of patterns (linear and nonlinear) represented by models, tables, sequences, or graphs in problem solving situations.

6 Look at the pattern shown in this graph.

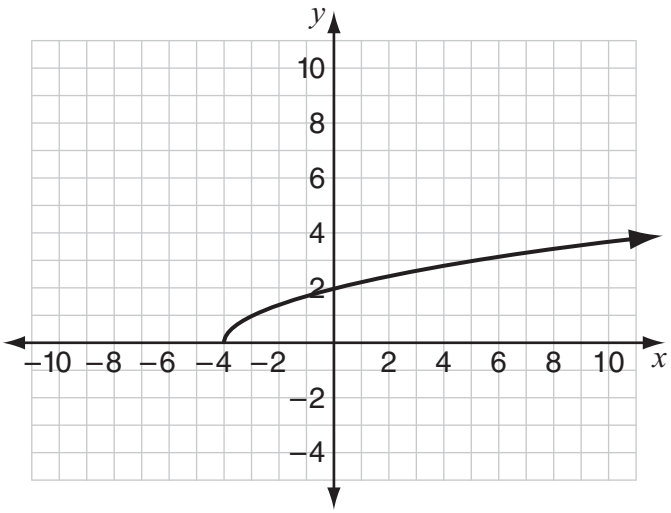


If the pattern continues, what will be the value of Term 7 of this pattern?

A. 27
B. 28
C. 29
D. 30

F&A 10.2 Demonstrates conceptual understanding of linear and nonlinear functions and relations (including characteristics of classes of functions) through an analysis of constant, variable, or average rates of change, intercepts, domain, range, maximum and minimum values, increasing and decreasing intervals and rates of change (e.g., the height is increasing at a decreasing rate); describes how change in the value of one variable relates to change in the value of a second variable; or works between and among different representations of functions and relations (e.g., graphs, tables, equations, function notation).

7 Look at this graph of a function. (y is a function of x.)



What is the domain of the function?

A. all real numbers
B. all real numbers except -4
C. all real numbers greater than or equal to 0
D. all real numbers greater than or equal to -4

F&A 10.3 **Demonstrates conceptual understanding of algebraic expressions** by solving problems involving algebraic expressions, by simplifying expressions (e.g., simplifying polynomial or rational expressions, or expressions involving integer exponents, square roots, or absolute values), by evaluating expressions, or by translating problem situations into algebraic expressions.

8 Which expression is equivalent to $(a + b)^2$?

A. $a^2 + b^2$

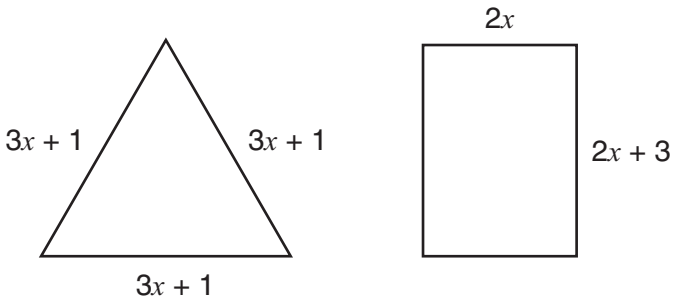
B. $2a + 2b$

C. $a^2 + ab + b^2$

D. $a^2 + 2ab + b^2$

F&A 10.4 **Demonstrates conceptual understanding of equality** by solving problems involving algebraic reasoning about equality; by translating problem situations into equations; by solving linear equations (symbolically and graphically) and expressing the solution set symbolically or graphically, or provides the meaning of the graphical interpretations of solution(s) in problem-solving situations; or by solving problems involving systems of linear equations in a context (using equations or graphs) or using models or representations.

9 Look at these two shapes.



The perimeter of the triangle is equal to the perimeter of the rectangle. Which equation **must** be true?

A. $3x + 1 = 2x + 2x + 3$

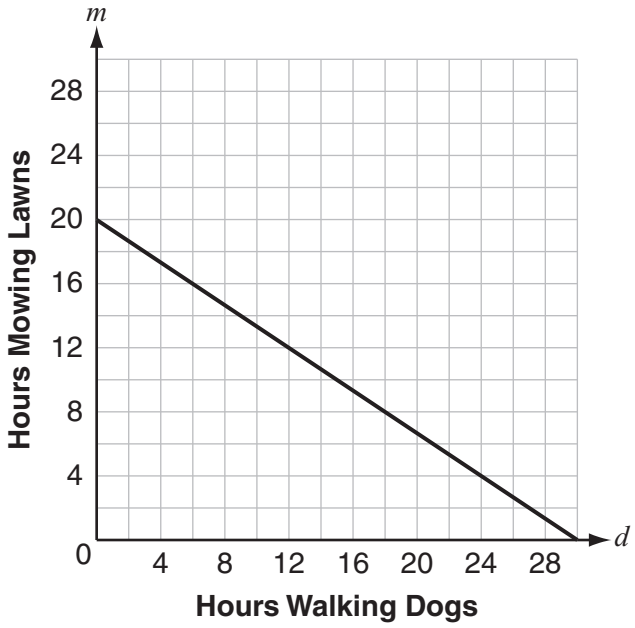
B. $3(3x + 1) = 2(2x + 3)$

C. $3 \bullet 3x + 1 = 2 \bullet 2x + 3$

D. $3(3x + 1) = 2(2x + 2x + 3)$

F&A 10.4 **Demonstrates conceptual understanding of equality** by solving problems involving algebraic reasoning about equality; by translating problem situations into equations; by solving linear equations (symbolically and graphically) and expressing the solution set symbolically or graphically, or provides the meaning of the graphical interpretations of solution(s) in problem-solving situations; or by solving problems involving systems of linear equations in a context (using equations or graphs) or using models or representations.

10 Adam wants to earn a total of $300 each week by walking dogs for *d* hours and mowing lawns for *m* hours. The graph below shows all possible numbers of hours Adam could walk dogs and mow lawns to earn exactly $300 a week.

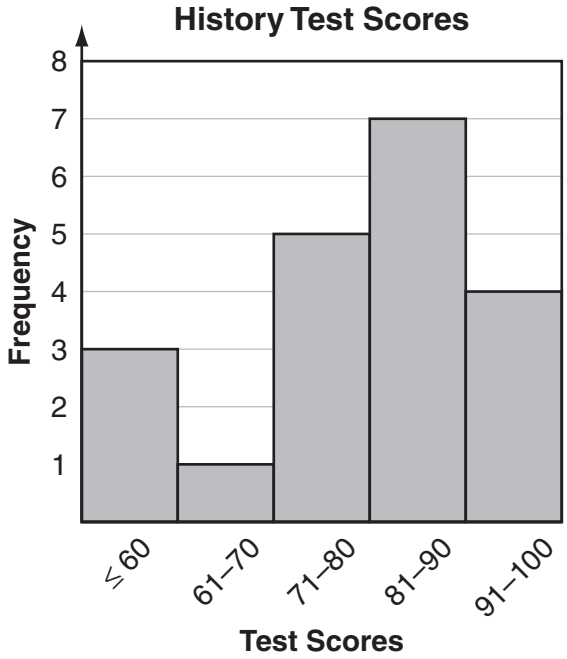


Last week Adam walked dogs for the same number of hours that he mowed lawns. He earned $300. How many **total** hours did Adam walk dogs and mow lawns last week?

A. 20
B. 24
C. 28
D. 30

DSP 10.1 **Interprets a given representation(s)** (e.g., box-and-whisker plots, scatter plots, bar graphs, line graphs, circle graphs, histograms, frequency charts) to make observations, to answer questions, to analyze the data to formulate or justify conclusions, critique conclusions, make predictions, or to solve problems within mathematics or across disciplines or contexts (e.g., media, workplace, social and environmental situations). (IMPORTANT: *Analyzes data consistent with concepts and skills in M(DSP)-10-2.*)

11 Look at this histogram.



Based on the histogram, which statement **must** be true?

A. The mode test score is 85.

B. Exactly four students scored 100.

C. The median test score is between 81 and 90.

D. One-fourth of the students scored higher than 90.

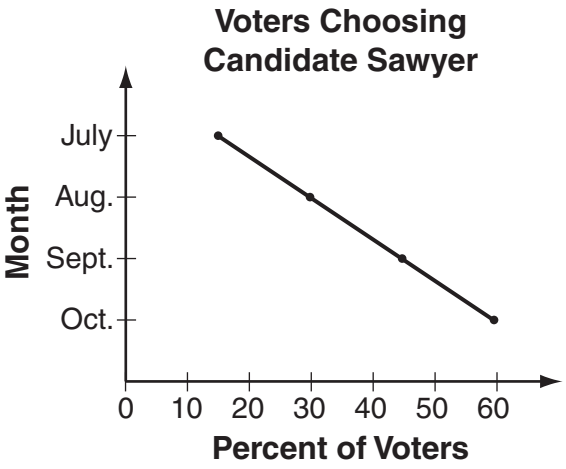
DSP 10.3 Identifies or describes representations or elements of representations that best display a given set of data or situation, consistent with the representations required in M(DSP)-10-1.

12 This table shows the results of polls taken during the four months preceding an election between two candidates—Sawyer and Hillman.

Percent of Voters Choosing Sawyer

July	Aug.	Sept.	Oct.
15%	30%	45%	60%

Hillman published this graph in a newspaper.



How could this graph be misleading about Sawyer's popularity?

A. The graph does not show the number of voters polled each month.

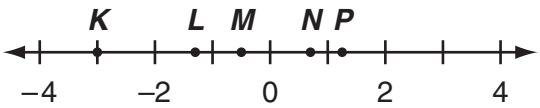
B. The graph does not show the percent of voters who chose Hillman.

C. The graph gives the impression that Sawyer's popularity is decreasing.

D. The graph gives the impression that Sawyer's popularity is changing at a constant rate.

N&O 10.2 Demonstrates understanding of the relative magnitude of real numbers by solving problems involving ordering or comparing rational numbers, common irrational numbers (e.g., $\sqrt{2}$, π), rational bases with integer exponents, square roots, absolute values, integers, or numbers represented in scientific notation using number lines or equality and inequality symbols.

13 Look at this number line.



Points K, L, M, N, and P are labeled on the number line. Identify all labeled points that are solutions to the inequality below.

$$0 < \frac{1}{x^2} < 1$$

Scoring Guide

Score	Description
1	Student gives the correct answer, ***K*, *L*, and *P* or appropriate numerical equivalent.**
0	Response is incorrect, contains some incorrect points, or does not contain all correct points.
Blank	No response

Note: Accept any correct analytical response (e.g., absolute value of x is greater than 1).

Score Point 1
(Example A)

13

P, L, K are all solutions.

Student's response is correct.

Score Point 0
(Example A)

13

−3, −1.2, −.5, .75

Student's response contains some incorrect points.

Score Point 0
(Example B)

13

K + L

Student's response does not contain all the correct points.

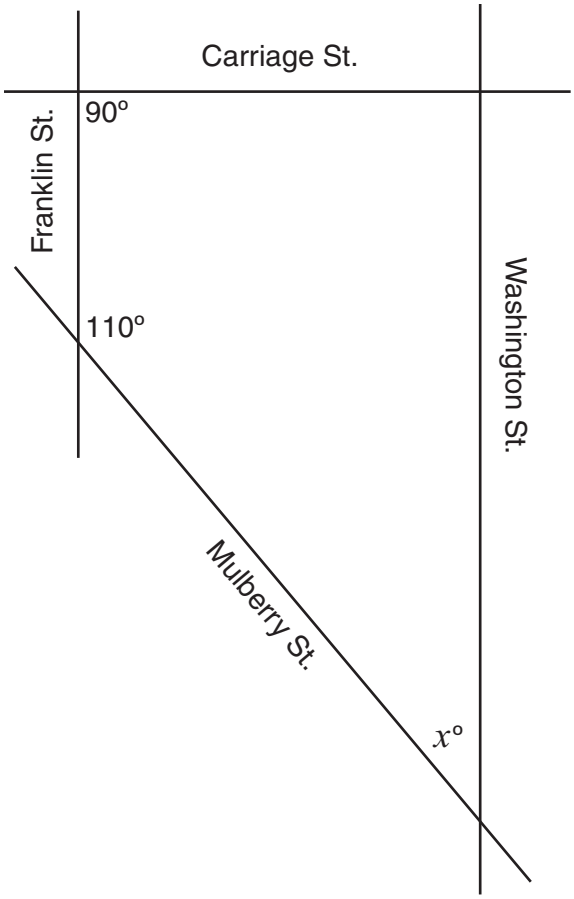
$0 < \frac{1}{-3(2)} < 1$ ✓

$0 < 1/9 < 1$

$\frac{\frac{1}{1/2}}{\frac{1}{1}}$ ✗

G&M 10.2 Makes and defends conjectures, constructs geometric arguments, uses geometric properties, or uses theorems to solve problems involving angles, lines, polygons, circles, or right triangle ratios (sine, cosine, tangent) within mathematics or across disciplines or contexts (e.g., Pythagorean Theorem, Triangle Inequality Theorem).

14 Look at this diagram.



not drawn to scale

Franklin St. is parallel to Washington St. What is the value of x?

Scoring Guide

Score	Description
1	Student gives the correct answer, **70**.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response

Score Point 1
(Example A)

14

$x° = 70°$ because an alternate interior angles

Student's response is correct.
(Explanation is not required.)

Score Point 1
(Example B)

14

70

Student's response is correct.

Score Point 0
(Example A)

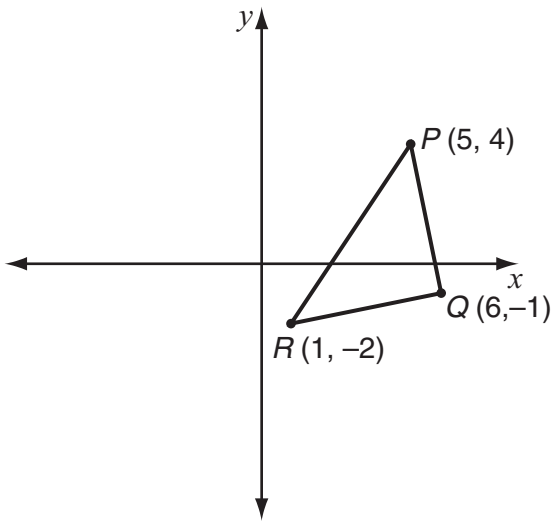
14

$110° + x = 160°$
$-110° \quad -110°$
$x = 50°$

Student's response is incorrect.

G&M 10.9 Solves problems on and off the coordinate plane involving distance, midpoint, perpendicular and parallel lines, or slope.

15 Look at $\triangle PQR$.



What are the coordinates of the midpoint of $\overline{RP}$?

Scoring Guide

Score	Description
1	Student gives the correct midpoint, **(3, 1).**
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response

Score Point 1
(Example A)

15

mid point of $\overline{RP}$ = (3, 1)

$\frac{1+5}{2}$ $\frac{-2+4}{2}$ $\frac{y_1+y_2}{2}$ $\frac{x_2+x_1}{2}$

Student's response is correct. (Showing work is not required.)

Score Point 1
(Example B)

15

Y = 1 X = 3

Student's response is correct.

Score Point 0
(Example A)

15

5 − 1 = 4 2 + 4 = 6

x-value = 2.5 y-value = 3.5

+ 1 − 2

3.5 1.5

(3.5, 1.5)

Student's response is incorrect.

Score Point 0
(Example B)

15

$m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{4+(-2)}{5-1} = \frac{6}{4}\ \frac{3}{2}$

Midpoint of $\overline{RP}$ is $\boxed{(3,2)}$

Student's response is incorrect.

Score Point 0
(Example C)

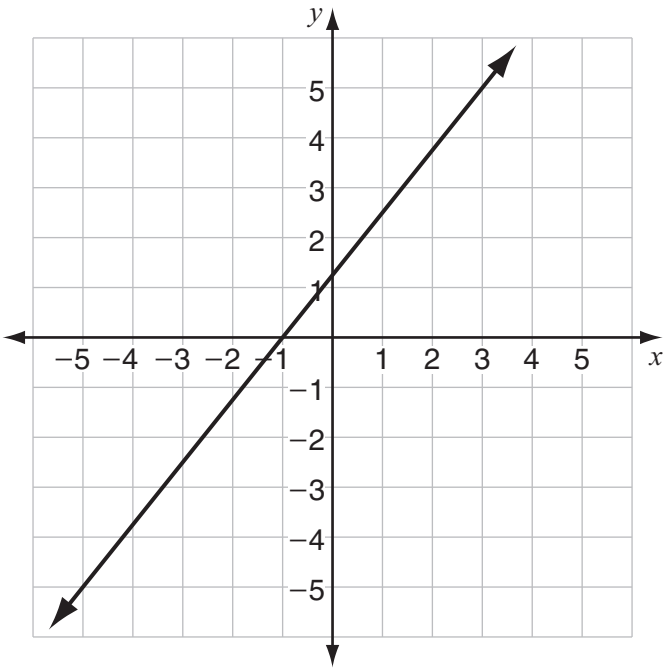
15

(1, 3)

Student's response is incorrect.

F&A 10.1 Identifies, extends, and generalizes a variety of patterns (linear and nonlinear) represented by models, tables, sequences, or graphs in problem solving situations.

16 This graph shows a linear relationship between x and y.



Based on the graph, what is the value of x when the value of y is 10?

Scoring Guide

Score	Description
1	Student gives the correct answer, **7**.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response

Score Point 1
(Example A)

16

$x = 7$

Student's response is correct.

Score Point 1
(Example B)

16

$(3,5)\ (-1,0)$

$\frac{10-5}{x-3} = \frac{5}{4}$

$\frac{0-5}{-1-3} = \frac{-5}{-4}$ slope $\frac{5}{4}$

$20 = 5x - 15$

$35 = 5x$ $x = 7$

Student's response is correct.
(Showing work is not required.)

Score Point 0
(Example A)

16

$\boxed{-10}$

Student's response is incorrect.

Score Point 0
(Example B)

16

$y = 1.125x + 1.25$

$y = 10$ $x = \approx 7.87$

Student's response is incorrect.

F&A 10.3 **Demonstrates conceptual understanding of algebraic expressions** by solving problems involving algebraic expressions, by simplifying expressions (e.g., simplifying polynomial or rational expressions, or expressions involving integer exponents, square roots, or absolute values), by evaluating expressions, or by translating problem situations into algebraic expressions.

17 Look at this equation.

$$y = \sqrt{10 + x}$$

Find one value of x that makes y an integer.

Scoring Guide

Score	Description
1	Student gives a correct value of x.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response

Score Point 1
(Example A)

17

$y = \sqrt{10+x}$

$1^2 = \sqrt{10+x}^2$

$1 = 10+x$

$\boxed{x = -9}$

Student's response is correct.
(Showing work is not required.)

Score Point 1
(Example B)

17

71

Student's response is correct.

Score Point 0
(Example A)

17

$y = \sqrt{10+2}$

$6 = \sqrt{12} = 2$

Student's response is incorrect.

Score Point 0
(Example B)

17

$y = \sqrt{10+x}$

$y = \sqrt{10+9}$

$y = \sqrt{100}$

$y = 10$

Student's response is incorrect.

F&A 10.4 **Demonstrates conceptual understanding of equality** by solving problems involving algebraic reasoning about equality; by translating problem situations into equations; by solving linear equations (symbolically and graphically) and expressing the solution set symbolically or graphically, or provides the meaning of the graphical interpretations of solution(s) in problem-solving situations; or by solving problems involving systems of linear equations in a context (using equations or graphs) or using models or representations.

18 Look at this equation.

$$1 + 3(x - 5) = 7 + x$$

What value of x will make this equation true?

Scoring Guide

Score	Description
1	Student gives a correct answer, **10.5 or equivalent**.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response

Score Point 1
(Example A)

18

$1+3(x-5)=7+x$

$1+3x-15=7+x$

$3x-15=6+x$

$3x=x+6+15$

$2x=21$

$x=\frac{21}{2}$

Student's response is correct. (Showing work is not required.)

Score Point 1
(Example B)

18

10.5

Student's response is correct.

Score Point 0
(Example A)

18

$1+3(x-5)=7+x$

$x=9$ because

$1+3(9-5)=7+9$

$1+3(9-5)=16$

$4(4)=16$

$16=16$

Student's response is incorrect.

Score Point 0
(Example B)

18

$1+3x-15=7+x$

$14+3x=7+x$

$-x \quad -x$

$14+2x=7$

$+14 \quad +4$

$\frac{2x}{2}=\frac{21}{2}$

$x=11$

Student's answer is incorrect. (No credit is given for correct strategy).

N&O 10.2 Demonstrates understanding of the relative magnitude of real numbers by solving problems involving ordering or comparing rational numbers, common irrational numbers (e.g., $\sqrt{2}$, π), rational bases with integer exponents, square roots, absolute values, integers, or numbers represented in scientific notation using number lines or equality and inequality symbols.

19 In these inequalities, both P and Q are **integers**.

- $\sqrt{2} < P < \sqrt{5}$
- $P < Q < \sqrt{10}$

What are all the possible integer values of Q? Show your work or explain how you know.

Scoring Guide

Score	Description
2	Student gives correct answer, **3**, with sufficient explanation or work shown to indicate correct strategy.
1	Student gives correct answer with insufficient or no explanation or work shown. OR Student gives appropriate strategy with incorrect or no answer.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response

Score Point 2
(Example A)

19

$Q=3$

$1<\sqrt{2}<2$
$2<\sqrt{5}<3$
$1<P<3$
$P=2$
$2<Q<4$
$3<\sqrt{10}<4$

Student's response is correct, with sufficient explanation.

Score Point 2
(Example B)

19

$\sqrt{2}<P<\sqrt{5}$
$1.\sim$ 2 $2.\sim$

$P<Q<\sqrt{10}$
$2<3<3.\sim$

$P=2$
$Q=3$

Student's response is correct, with sufficient explanation.

Score Point 2
(Example C)

19

$P=\{\sqrt{5},\sqrt{9}\}$

Possible int. $=3$ or $\sqrt{9}$

$\sqrt{9}<Q<\sqrt{10}$

$Q=\{\sqrt{5},\sqrt{6},\sqrt{7},\sqrt{8},\sqrt{9}\}$

Student's response is correct, with sufficient explanation.

Score Point 1
(Example A)

19

2. is only number that would fit criteria for P

3 only number that fits for Q

Student's response is correct, with insufficient explanation.

Score Point 1
(Example B)

19

Q=3

Student's response is correct, with no explanation.

Score Point 0
(Example A)

19

$\sqrt{2} < P < \sqrt{5}$ $\quad$ $P < Q < \sqrt{10}$

$4 < 10 < 25$ $\quad$ $10 < 50 < 100$

I just guessed and after I checket my work and it work.

Student's response is incorrect.

Score Point 0
(Example B)

19

$\sqrt{2} < p < \sqrt{5}$

$P < Q < \sqrt{10}$

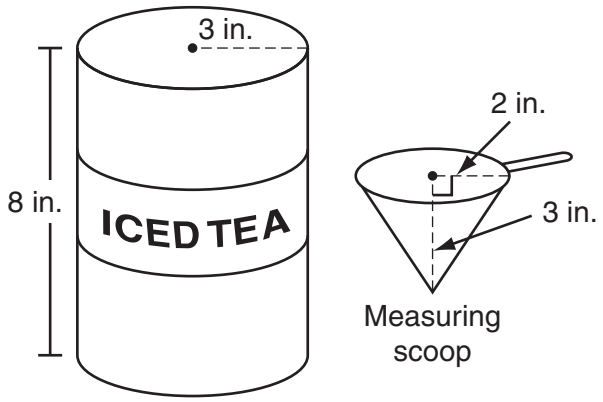
$P = \sqrt{3}$

$Q = \sqrt{5}$

Student's response is incorrect.

G&M 10.6 Solves problems involving perimeter, circumference, or area of two-dimensional figures (including composite figures) or **surface area or volume** of three-dimensional figures (including composite figures) within mathematics or across disciplines or contexts.

20 This diagram shows a cylindrical container of iced tea mix and a cone-shaped measuring scoop.



One level measuring scoop of iced tea mix makes one pitcher of iced tea. How many pitchers of iced tea can be made from this full container of iced tea mix? Show your work or explain how you know.

Scoring Guide

Score	Description
2	Student gives the correct answer, **18**, and provides appropriate work or explanation.
1	Student gives correct answer but does not provide appropriate work or explanation. OR Student's work or explanation shows correct strategy in solving the problem but contains an error in computation.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response

Score Point 2
(Example A)

20

$\pi r^2 h$

$\pi(3)^2(8)$

Tea mix = 226 in^3

$\frac{1}{3}\pi r^2 h$

$\frac{1}{3}(\pi)(2)^2(3)$

scoop = 13 in^3

$\frac{\text{Mix}}{\text{scoop}} = 17$

17 pitchers can be made

Correct rounding is acceptable, even if the resulting answer is different from 18.

Student's response is correct, with sufficient work shown to indicate correct strategy.

Score Point 2
(Example B)

20

$\frac{226.08 \text{ m}^3 \text{ of iced tea mix}}{12.56 \text{ m}^3 \text{ in scoop}} = 18$ pitchers of iced tea.

Student's response is correct, with sufficient work shown to indicate correct strategy.

Score Point 1
(Example A)

20

$3 \times 3 = 9 \times 3.14 = 28.26 \times 8\text{in} = 226.08$

$B \times h$

$2 \times 2 = 4 \times 3.14 = 12.56 \times 3 = 37.68 \times .03 = 1.13$

$226.08 \div 1.13 = 200$ pitchers.

Student's strategy is appropriate, with incorrect answer.

Score Point 1
(Example B)

20

$V_c = h \cdot \pi r^2$
$= 8 \cdot \pi 3^2$
$= 8 \cdot 9\pi$
$= 72\pi$

$V_s = \frac{1}{3}\pi r^2 h$
$= \frac{1}{3}\pi 2^2 \cdot 3$
$= \frac{1}{3}\pi 4 \cdot 3$
$= 4\pi$

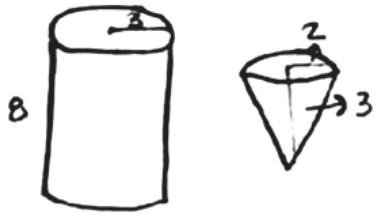
V_c = Volume of cylinder
V_s = Volume of scoop

$\frac{V_c}{V_s} = \frac{72\pi}{4\pi} =$ 9 pitchers

Student's strategy is appropriate, with incorrect answer.

Score Point 0
(Example A)

20



cylinder =
$A = \pi 3^2$
$A = 28.3$
$V = 8(28.3)$
$V = 226.4$

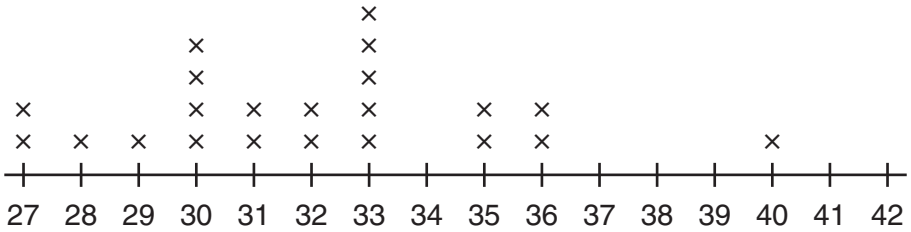
scoop =
$A = \pi 2^2$
$A = 12.6$
$V = 3(12.6)$
$V = 37.8$

$226.4 \div 37.8 =$ 6 scoops

Student's response is incorrect. Partially correct strategy is insufficient to receive credit.

DSP 10.2 **Analyzes patterns, trends, or distributions in data in a variety of contexts** by determining, using, or analyzing measures of central tendency (mean, median, or mode), dispersion (range or variation), outliers, quartile values, estimated line of best fit, regression line, or correlation (strong positive, strong negative, or no correlation) to solve problems; and solve problems involving conceptual understanding of the sample from which the statistics were developed.

21 Look at this line plot.



Ages of Medical School Students

When three additional students' ages are included in the data, the mode age changes but the median age remains the same. What could be the ages of the three additional students? Be sure to list each of the three ages. Explain your reasoning.

Scoring Guide

Score	Description
2	Student gives a correct age for each of the three students and provides a reasonable explanation.
1	Student gives a correct age for each of the three students but provides no explanation. OR Student gives a correct age for each of two students and provides a partially correct or incomplete explanation.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response

Score Point 2
(Example A)

21 The ages of the additional three students could be 30, 30 and 34.

The original median is 32. The original mode is 33. The closest number to the mode is 30. Therefore 2 of the students being 30, surpasses the old mode to now be 30. Then the third student is 34 because it sets the median back to 32.

Student's response is correct, with reasonable explanation for both requirements.

Score Point 2
(Example B)

21 Before median = 32
Before mode = 33

After median = 32
After mode = 30

Ages Added = 30yrs, 30yrs, 36yr.

when you add the two 30 year olds it changes the mode. Then you must add a 36yr old or anyone over 32 to keep the median the same.

Student's response is correct, with reasonable explanation for both requirements.

Score Point 1
(Example A)

21

Ages of three students:
30, 30, 32

27 27 28 29 30 30 30 30 30 30 31 31 32 32 32 33 33 33 33 33
35 35 36 36 40

32 - median
33 - mode

Student's response is correct, with reasonable explanation for one requirement.

Score Point 1
(Example B)

21

32 = median

2 could be 30 and 1 could be 40

Student's response is correct, with insufficient explanation.

Score Point 1
(Example C)

21

median = $\frac{704}{22}$ = 32

mode now = 33

could have 32, 32, 32 because the average of those ages is 32, so the total average would not change, but the mode would be 33 and 32 which is different, so its correct

Student's response is correct, with reasonable explanation for one requirement (the mode).

Score Point 0
(Example A)

21

The mode age is 32 to begin with, the median age 33. To change the the mode to 33 04, the ages of the 3 students would have to be 40, 40 and 42. Anywhere far away from the mode age will change it, anywhere past 38 or 39.

Student's response is incorrect.

SCORE POINT 0
(EXAMPLE B)

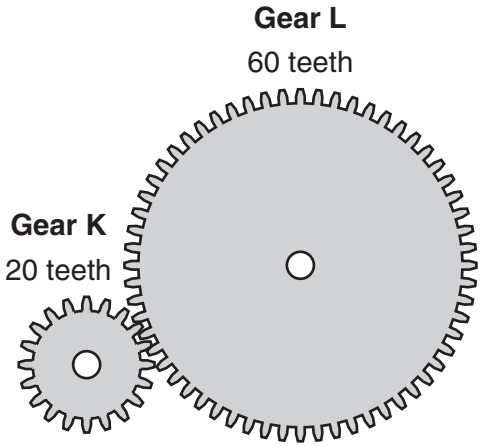
21

32 because that is the median.

Student's response is incorrect. Partially correct explanation is insufficient to receive credit.

G&M 10.7 Uses units of measure appropriately and consistently when solving problems across content strands; makes conversions within or across systems and makes decisions concerning an appropriate degree of accuracy in problem situations involving measurement in other GRs.

22 This diagram shows two gears with interlocking teeth.



a. If Gear K makes 120 revolutions, how many revolutions does Gear L make?

b. If Gear L makes 15 revolutions per minute, how many revolutions does Gear K make in **one hour**? Show your work or explain how you know.

Gear Q and Gear R are two other gears with interlocking teeth.

- Gear Q has 50 teeth.
- Gear R has 75 teeth.

c. If Gear Q makes 7200 revolutions per hour, how many revolutions does Gear R make in **one minute**? Show your work or explain how you know.

Scoring Guide

Score	Description
4	5 points
3	4 points OR 3 correct answers only
2	2–3 points
1	1 point
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response

Training Notes:

Part a: 1 point for the correct answer, **40** (revolutions)

Part b: 2 points for the correct answer, **2700** (revolutions), with sufficient explanation or work shown to indicate correct strategy

OR

1 point for the correct answer with insufficient or no explanation or work shown

or

for appropriate strategy with incorrect or no answer

Part c: 2 points for the correct answer, **80** (revolutions), with sufficient explanation or work shown to indicate correct strategy

OR

1 point for the correct answer with insufficient or no explanation or work shown

or

for appropriate strategy with incorrect or no answer

Score Point 4
(Example A)

22

a. 40 revolutions

b. 20:60 = 1:3 or $\frac{1}{3}$ $\quad 15 \times 3 = 45$

$45 \times 60 = 2700$

2700 rph

c. 50:75 = 2:3 or $\frac{2}{3}$

$\frac{7200}{3} \times 2 = 2400 \times 2 = 4800$

4800 rph

$\frac{4800}{60} =$ 80 rpm

a) Student's response is correct (units are not required).

b) Student's response is correct, with sufficient work shown to indicate correct strategy.

c) Student's response is correct, with sufficient work shown to indicate correct strategy.

Score Point 4
(Example B)

22

a) $120 \cdot 20 = 2400/60 =$ 40 revolutions

b) $15 \cdot 60 = 900/20 = 45 \cdot 60 =$ 2700 revolutions

c) $7200 \cdot 50 = 360000/75 = \frac{4800}{60} =$ 80 revolutions

a) Student's response is correct. (Showing work is not required.)

b) Student's response is correct, with sufficient work shown to indicate correct strategy.

c) Student's response is correct, with sufficient work shown to indicate correct strategy.

Score Point 3
(Example A)

22

a) 120/3 = 60 revolutions

b) 15 rev/min x 3 rev = 45/min

45 x 60 = 2700/hr

c) 7200/hr - /60 = 120/min

120(2/3) = 80 rev/min

a) Student's response is incorrect.

b) Student's response is correct, with sufficient work shown to indicate correct strategy.

c) Student's response is correct, with sufficient work shown to indicate correct strategy.

Score Point 3
(Example B)

22

A. 40

b. 2,700

C. 80

Student's answers to all three parts are correct.

Score Point 3
(Example C)

22

a) 120 ÷ 3 = 40

b) 15 x 60 = 900 x 3 = 2700

c) 7200 x 3/3 = 12000 ÷ 60 = 200

a) Student's response is correct. (Showing work is not required.)

b) Student's response is correct, with sufficient work shown to indicate correct strategy.

c) Student's strategy is appropriate, with incorrect answer.

Score Point 2
(Example A)

22

A) 40

B) 2,700

C)
```
      120
60 ) 7200
     -60
     ----
      120
     -120
     ----
        0
```

$\boxed{120}$

a) Student's response is correct.

b) Student's response is correct, with no explanation or work shown.

c) Student's response is incorrect.

Score Point 2
(Example B)

22

a) L:K
1:3

40 rev. $\frac{1}{3} = \frac{40}{120}$

a) Student's response is correct. (Showing work is not required.)

b) 900 rph - L $\frac{1}{3} = \frac{900}{x}$

2700 rph.

b) Student's response is correct, with sufficient work shown to indicate correct strategy.

R:Q
3:1

c) Q - 120 rpm

$\frac{3}{1} = \frac{x}{120}$

360 rpm

c) Student's response is incorrect. Partially correct strategy is insufficient to receive credit.

Score Point 1
(Example A)

22

A) 120
÷ 3
40 revolutions

a) Student's response is correct. (Showing work is not required.)

B) 45 rev. per min.
45 x 24 = 1080 rev.

b) Student's response is incorrect.

C) 7200 x 25 = 180,000
÷ 60
3,000

c) Student's response is incorrect.

SCORE POINT 0
(EXAMPLE A)

22

a. gear "L" will make 80 revolutions.

b. 15*60: 900 per hour.
-40
860

K: 860 per hour

c. Q = 50 teeth
R: 75 teeth

Q: 7,200 revolutions per hour
R: per minute

$\frac{7200}{60}$ = 120 + 25 = R: 145 revolutions per minute, the equation $\frac{7200}{60}$ = 120 + 25 because there are 25 more teeth in R than Q will get you 145 revolutions.

Student's response to each part is incorrect. Partially correct strategy in parts b and c is insufficient to receive credit.

SCORE POINT 0
(EXAMPLE B)

22

a. 120
· 3
360

Gear L = 360 revolutions

b. 15
· 3
45

45 revolutions per min.

c. 7200 · .5 = 3600.0

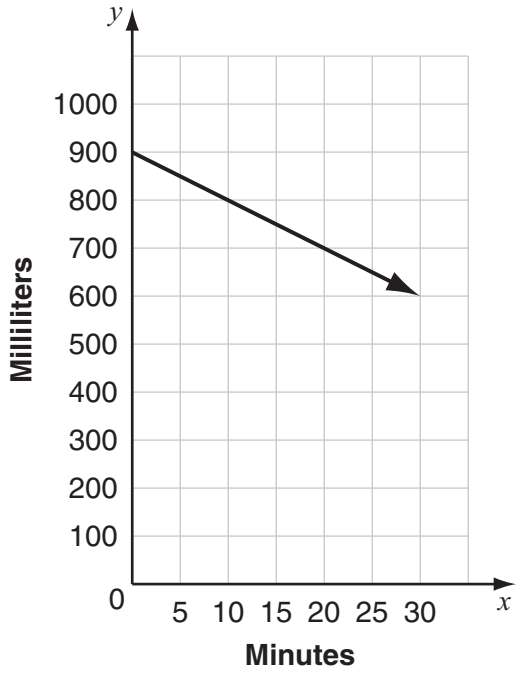
3600 · .6 = 2160

2160 revolutions in one minute

Student's response to each part is incorrect.

F&A 10.2 Demonstrates conceptual understanding of linear and nonlinear functions and relations (including characteristics of classes of functions) through an analysis of constant, variable, or average rates of change, intercepts, domain, range, maximum and minimum values, increasing and decreasing intervals and rates of change (e.g., the height is increasing at a decreasing rate); describes how change in the value of one variable relates to change in the value of a second variable; or works between and among different representations of functions and relations (e.g., graphs, tables, equations, function notation).

23 A liquid solution is slowly leaking from a container. This graph shows the milliliters of solution, y, remaining in the container after x minutes.



a. What is the y-intercept of the line?

b. What is the slope of the line?

c. What does the slope of the line represent?

d. Use the graph and your answer from part b to predict the number of minutes it will take for the container to empty if the solution continues leaking at the same rate. Show your work or explain how you know.

Scoring Guide

Score	Description
4	5 points
3	4 points
2	2 or 3 points
1	1 point
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response

Training Notes:

Part a: 1 point for the correct *y*-intercept, **(0, 900)**

Part b: 1 point for the correct slope, **–10 or equivalent**

Part c: 1 point for a correct explanation

Part d: 2 points for the correct answer, **90** (minutes) **or equivalent**, with work shown or explanation given

OR

1 point for the correct answer, with no work shown or explanation given

or

1 point for correct strategy shown in solving the problem, but there is a computation error

Note: Also accept response of *y*-intercept = 900 for part a.

SCORE POINT 4
(EXAMPLE A)

23

a) 900 mL

b) (0,900)(20,700)

$m = \frac{900-700}{0-20} = \frac{200}{-20} = -10$

c) The slope of the line represents the amount of liquid solution that leaks from the container every minute.

d) $y = mx + b$
$y = -10x + 900$
$0 = -10x + 900$
$-900 = -10x$
$90 = x$

90 minutes

Every minute, 10 mL of liquid leaks out of the container. Since the container initially had 900 mL and 10 mL leak every minute, it takes 90 mins for the container to be empty.

a) Student's response is correct. (Correct units are not required.)

b) Student's response is correct. (Showing work is not required.)

c) Student's explanation is correct.

d) Student's response is correct, with sufficient explanation to indicate correct strategy.

SCORE POINT 4
(EXAMPLE B)

23

a (0,900)

b $\frac{-100}{10} = -10$

c decrease in milileters of solution in the container per 5 minutes

d $y = -10x + 900$
$0 = -10x + 900$
$\frac{10x}{10} = \frac{900}{10}$ $x = 90$

90 minutes

a) Student's response is correct.

b) Student's response is correct.

c) Student's explanation is correct.

d) Student's response is correct, with sufficient explanation to indicate correct strategy.

Score Point 3
(Example A)

23

A: y-intercept: 900 ml

B. slope: $\frac{-1}{2}$

C. The container drops 100 ml every ten minutes

D. 90 minutes

Minutes	ml
30	600
40	500
50	400
60	300
70	200
80	100
90	0

a) Student's response is correct. (Correct units are not required.)

b) Student's response is incorrect.

c) Student's explanation is correct.

d) Student's response is correct, with sufficient work shown to indicate correct strategy.

Score Point 3
(Example B)

23

a: 900

b: (0,900), (10,800)

slope = -10

$\frac{800-900}{10-0} = \frac{-100}{10} = -10$

c: a decrease in the amount of fluid in the container

d: It will take 90 minutes. when the equation ($y = -10x + 900$) is graphed, it crosses the x-axis at point (90,0)

a) Student's response is correct.

b) Student's response is correct. (Showing work is not required.)

c) Student's explanation is insufficient.

d) Student's response is correct, with sufficient explanation to indicate correct strategy.

Score Point 2
(Example A)

23

a. 900 milliliters
b $-3/6$ or $-1/2$
c. The Slope of the line represents how much liquid is left after x minutes and how it is decreasing
d. It will take 1 more hour or 1hr 30min total
- 300ml in 30min
900 total 3sets of 300
3*30 is 1hr 30.

a) Student's response is correct. (Correct units are not required.)

b) Student's response is incorrect.

c) Student's explanation is insufficient and contains some incorrect elements.

d) Student's response is correct, with sufficient explanation to indicate correct strategy.

Score Point 2
(Example B)

23

A.) 900
B.) $-50/5$
C.) Ch.
D.) —

Student's responses to parts a and b are correct.

Student's response to part c is irrelevant and student did not respond to part d.

Score Point 1
(Example A)

23

A. y-intercept = 900

B. slop = $-\frac{3}{40}$

C. The slope tells you that the graph is a negative graph.

D. I predict it will take 444 minutes for the container to empty out. I find this by first taking 100(the total amount of milimeters) and dividing it by 3(how many come out in 40 mins. I then divided 40 by 3, giving 13.$\overline{33}$ and multiplied that number by 33.$\overline{33}$ to get 444.28. I rounded up to get 444 mins.

$3\overline{)100}$ = 33.$\overline{33}$ $\quad$ $3\overline{)40}$ = 13.33 $\quad$ $\begin{array}{r} 33.33 \\ \times\ 13.33 \\ \hline 444.28 \end{array}$

Student's response to part a is correct.

Score Point 1
(Example B)

23

1 hour and half it will have driped all out.

C. Negitive Cocralation

100 mililiters per minute

Student's response to part d is correct, with no explanation or work shown.

Score Point 1
(Example C)

23

a → 900

b → $\frac{1}{2}$

C → $\frac{\text{rise}}{\text{run}}$

d → It will take about 40 minutes because its already half way down.

Student's response to part a is correct.

Score Point 0
(Example A)

23

(A) → The line y is the militers.

(B) → IIs 30 Minutes.

(C) → IIs 900 Militers

(D) → IT take about 30 minutes to empty the container. Because IT say IN the graph.

No credit given in part c for response that would be correct for part a.

Student's response to each part is incorrect.

SCORE POINT 0
(EXAMPLE B)

23

A) y = milliliters.

B) x

C) X = minutes

D) I predict it will take from an hour to 1 hour 1/2 (60 min/90 min) to leak all the solution.

Student's response to each part is incorrect.

No credit is given for answer expressed as an interval, even though the interval includes the correct answer.