

AIMS HS Mathematics Sample Test and Think-Throughs

FOR STUDENTS

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HIGH SCHOOL



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Directions:**Read each problem and select the best answer.**

- 1 Sandra wrote the sequence below.

2, 5, 10, 17, . . .

Which equation represents the rule for finding the n th term of this sequence?

- A $a_n = n + 1$
 B $a_n = 2n^2$
 C $a_n = n^2 + 1$
 D $a_n = 2n + 1$
- 2 A team has twelve 15-year-old players and eight 16-year-old players. The coach of the team is 43 years old. Which measure of central tendency best represents the ages of the team, including the coach, and why?
- A Mean, because it is not affected by the age of the coach.
 B Median, because it is not affected by the age of the coach.
 C Mean, because it includes the age of everyone on the team.
 D Mode, because it includes the age of everyone on the team.
- 3 Which does **not** represent y as a function of x ?
- A $x = y^2 + 2$
 B $y = x^2 + 2$
 C $x = y + 8$
 D $y = -x + 8$

- 4 Jessica deposits \$300 into a savings account that pays an annual interest rate of 2%, compounded twice a year. How much money will Jessica have in her account at the end of one year?

- A \$304.00
 B \$306.00
 C \$306.03
 D \$312.12

- 5 A telephone company wants to create as many 7-digit phone numbers as possible without changing the first 3 digits. How many phone numbers can be created?

- A 21
 B 40
 C 6,561
 D 10,000

- 6 How much greater is the volume of a cube when the length of each edge is multiplied by 3?

- A 3 times as great
 B 6 times as great
 C 9 times as great
 D 27 times as great

Go On ►

- 7 The data below represents the scores for a soccer team in seven games.

0 0 0 1 1 2 10

Which measure of central tendency **best** represents the overall performance of the soccer team, and why?

- A Mean, because it shows the average scores.
 B Median, because it is the average of all scores.
 C Mean, because it not affected by an extreme score.
 D Median, because it is not affected by an extreme score.
- 8 Look at the recursive formula.

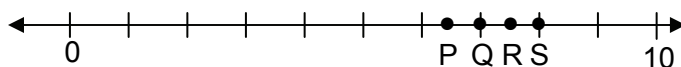
$$A_1 = 6$$

$$\text{For } n > 1, A_n = A_{(n-1)} + 4$$

What are the first 4 terms of this sequence?

- A 5, 6, 7, 8
 B 6, 10, 14, 18
 C 9, 12, 15, 18
 D 10, 14, 18, 22
- 9 Which point on the number line shows the **best** estimate of the irrational number below?

$$\sqrt{57}$$



- A P
 B Q
 C R
 D S

Go On ►

10 What is the value of x ?

$$3\sqrt{9+x} = 15$$

- A -4
- B 6
- C 16
- D 36

11 Figure $EFGH$ has a perimeter of 40 cm and an area of 96 cm^2 . It is dilated by a factor of $\frac{1}{4}$ to create figure $E'F'G'H'$. What statement about the perimeter (P) and the area (A) of figure $E'F'G'H'$ is true?

- A $P = 10 \text{ cm}$; $A = 6 \text{ cm}^2$
- B $P = 10 \text{ cm}$; $A = 24 \text{ cm}^2$
- C $P = 160 \text{ cm}$; $A = 192 \text{ cm}^2$
- D $P = 160 \text{ cm}$; $A = 384 \text{ cm}^2$

12 The area of a larger square is 16 times the area of a smaller square. How many times as long is the base of the larger square than the base of the smaller square?

- A 2 times as long
- B 4 times as long
- C 8 times as long
- D 16 times as long

13 What is the distance between -4 and 3 ?

- A -7
- B -1
- C 1
- D 7

14 Six differently colored balls (red, blue, green, orange, purple, and white) are placed in a basket. Without looking, three balls are removed. What is the total number of combinations that include a red ball?

- A 3
- B 10
- C 20
- D 60

15 Which pair of events is dependent?

- A roll a fair cube; flip a coin
- B flip a coin; flip the coin again
- C select a card from a deck, then keep it; select another card
- D select a card from a deck, then put it back; select another card

16 Which statement has a false inverse?

- A If $\sqrt{x} = 1$, then $x = 1$.
- B If $x^2 = 0$, then $x = 0$.
- C If $x = -2$, then $x^2 = 4$.
- D If $x + 3 = 5$, then $x = 2$.

17 Joe has the following information about a trapezoid.

Area: 14 square centimeters
 Base lengths: b_1 is 5 centimeters
 b_2 is unknown
 Height: 2 centimeters

Which equation can Joe write to find the unknown base length, b_2 , for the trapezoid?

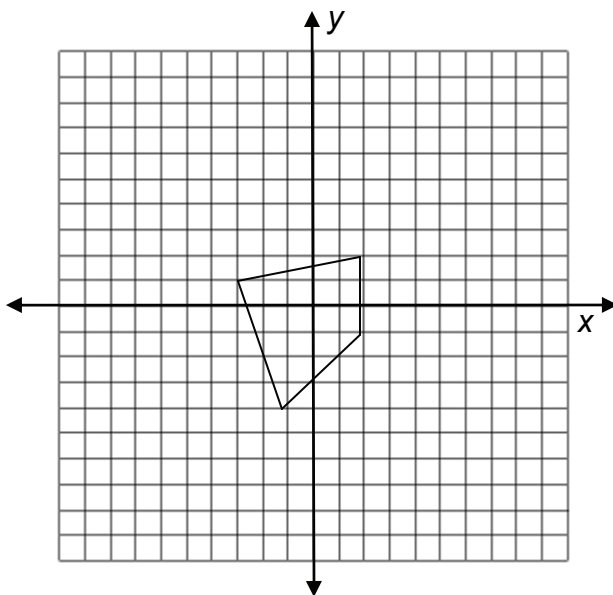
A $b_2 = \frac{2A}{h} - b_1$

B $b_2 = \frac{2A - b_1}{h}$

C $b_2 = \frac{hb_1}{2} - A$

D $b_2 = 2A - hb_1$

18 The coordinates (2, 2) and (-3, 1) are two of the vertices of the figure on the coordinate plane.



What are the coordinates of the midpoint of the two vertices?

A $\left(-\frac{1}{2}, \frac{3}{2}\right)$

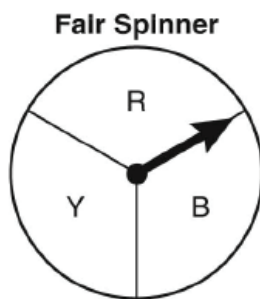
B $\left(-\frac{3}{2}, \frac{1}{2}\right)$

C $\left(\frac{1}{2}, \frac{3}{2}\right)$

D $\left(\frac{3}{2}, \frac{1}{2}\right)$

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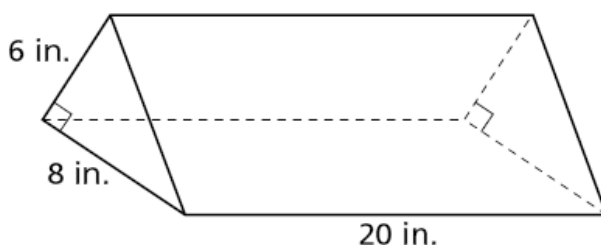
- 19** Debbie and Jamal each performed an experiment in which they spun a fair spinner 12 times. They recorded their results.



Spin	1	2	3	4	5	6	7	8	9	10	11	12
Debbie's Results	R	Y	B	R	Y	B	R	Y	B	Y	Y	Y
Jamal's Results	B	Y	B	R	Y	R	R	B	R	R	B	Y

Which outcome has a probability of 0?

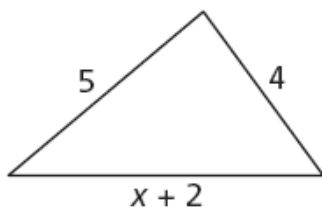
- A** After 3 more spins, Jamal will have a total of 8 results of R.
- B** After 6 more spins, Debbie will have a total of 12 results of Y.
- C** After 3 more spins, Debbie's results match the expected results based on theoretical probability.
- D** After 6 more spins, Jamal's results match the expected results based on theoretical probability.
- 20** Look at the 3-dimensional figure.



What is the total surface area of the figure?

- A** 328 in^2
- B** 480 in^2
- C** 504 in^2
- D** 528 in^2

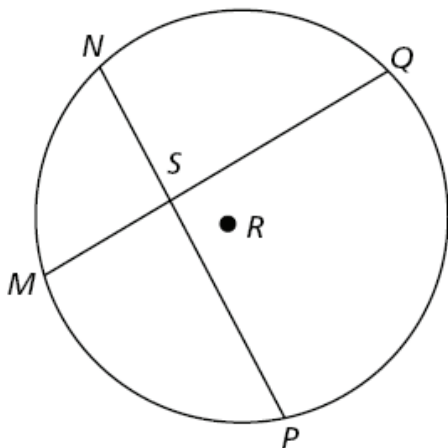
21 Look at the triangle.



What is **not** a possible value of x ?

- A 0
- B 3
- C 5
- D 7

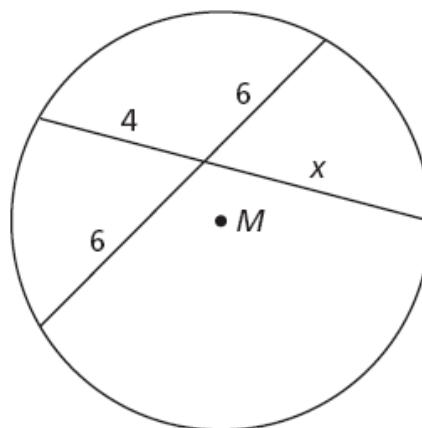
22 Chords \overline{NP} and \overline{MQ} intersect at point S in circle R .



If $MS = 3$, $NS = 2$, and $SQ = 8$, what is the length of \overline{SP} ?

- A 9
- B 12
- C 14
- D 24

23 Look at circle M .



What is the value of x ?

- A 4
- B 8
- C 9
- D 12

24 Which table represents y as a function of x ?

A

x	1	2	3	2	1
y	1	2	3	4	5

B

x	4	5	4	3	2
y	-6	-5	-4	-3	-2

C

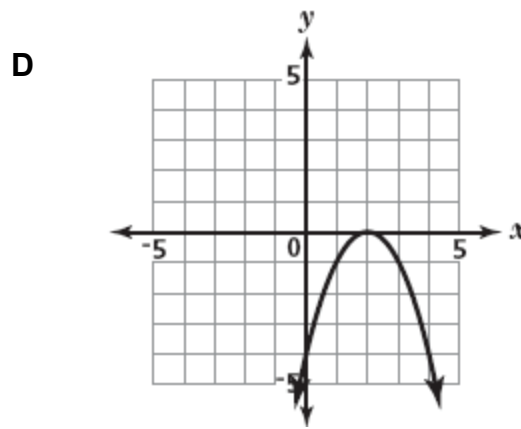
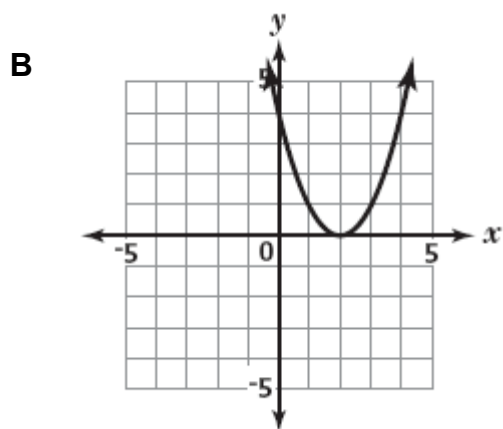
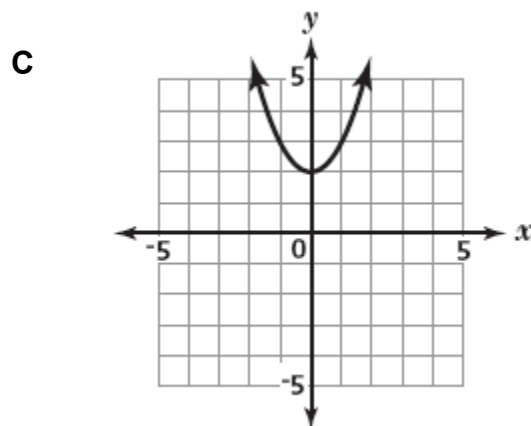
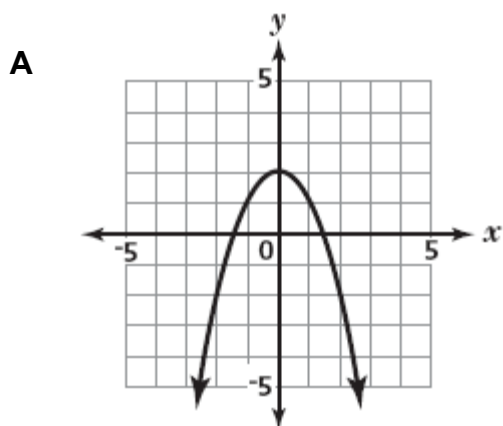
x	8	7	6	5	4
y	-1	2	-1	2	-1

D

x	3	4	3	2	3
y	0	1	2	1	3

25 What is the graph of the equation?

$$y = x^2 - 4x + 4$$



26 What are the values of x in the equation shown?

$$2|3x - 4| = 20$$

A $-\frac{14}{3}, \frac{14}{3}$



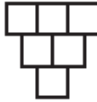
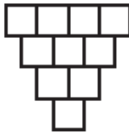
B $-2, \frac{14}{3}$

C $-\frac{14}{3}, 2$

D $-4, \frac{8}{3}$

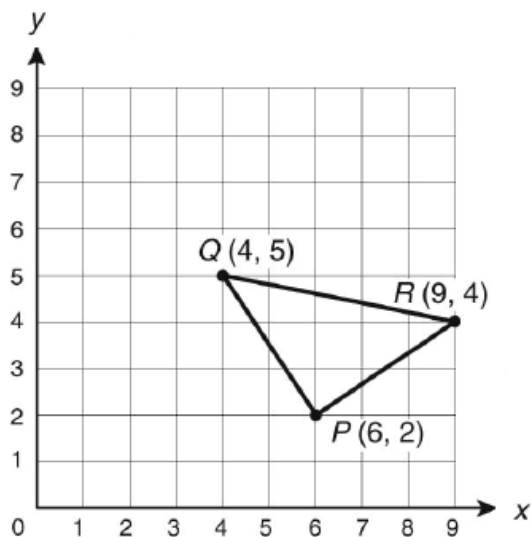
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- 27** The table shows a sequence of figures, the number of squares in each figure, and the perimeter of each figure.

Figure				
Number of squares	1	3	6	10
Perimeter	4	8	12	16

Based on the pattern shown, which conjecture is valid?

- A** A figure with 4 squares has a perimeter of 10.
B A figure with 8 squares has a perimeter of 14.
C A figure with 20 squares has a perimeter of 14.
D A figure with 28 squares has a perimeter of 28.
- 28** Triangle PQR is shown.



What are the coordinates of P' when $\triangle PQR$ is dilated by a scale factor of 3 using the origin as the center?

- A** (6,18)
B $\left(3, \frac{2}{3}\right)$
C $\left(\frac{2}{3}, 3\right)$
D (18,6)

Go On ►

29 What is the value of the expression?

$$\sqrt{64x^{16}y^4}$$

- A $8x^4y^2$
- B $8x^8y^2$
- C $32x^4y^2$
- D $32x^8y^2$

30 What is the solution to the equation shown?

$$\sqrt{3x-1} = 8$$

- A 3
- B $\frac{17}{3}$
- C $\frac{65}{3}$
- D 27

31 What is the complete factorization of the polynomial shown?

$$5x^3 - 20x^2 - 25x$$

- A $x(5x^2 - 20) - 25$
- B $5x(x+5)(x-1)$
- C $5x(x-5)(x+1)$
- D $x(5x^2 - 20x - 25)$

32 Look at the following equations.

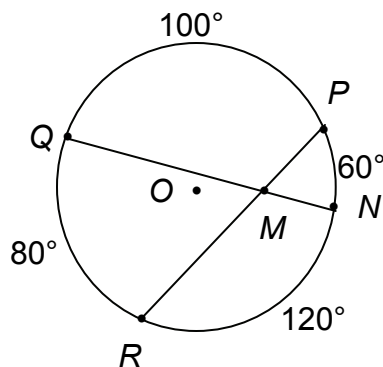
$$8p = 12 - 2q$$

$$q + 4p = 6$$

Which statement is true about the lines graphed from the equations?

- A They coincide.
- B They are parallel.
- C They are perpendicular.
- D They intersect but are not perpendicular.

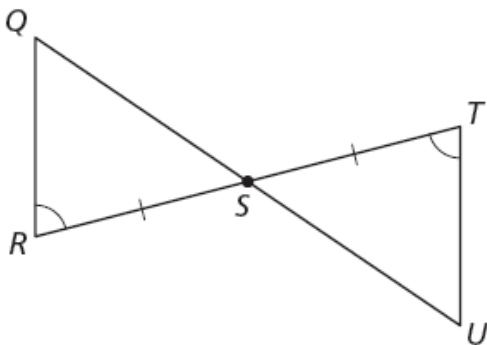
33 Points N , P , R , and Q lie on circle O .



In circle O , what is the $m\angle PMN$?

- A 30°
- B 60°
- C 70°
- D 140°

- 34** In the diagram below, \overline{RT} intersects \overline{QU} at point S .



Which postulate should be used to prove that $\triangle RQS \cong \triangle TUS$?

- A Side-Side-Side
 - B Angle-Side-Angle
 - C Angle-Side-Side
 - D Side-Angle-Side
- 35** Assume the statement shown below is true.

“If P , then Q .”

Based on this assumption, which of the following must be true?

- A If Q , then P .
- B If P , then not Q .
- C If not P , then not Q .
- D If not Q , then not P .

- 36** Look at the expression.

$$-2a [-2a (-2a + 4b) + 3b (-a - 6)]$$

Which of the following correctly simplifies the expression?

- A $-2a [4a^2 - 8ab - 3ab - 18b]$
 $-2a [4a^2 - 5ab - 18b]$
 $-8a^3 + 10a^2b + 36b$
- B $-2a [4a^2 - 8ab - 3ab - 18b]$
 $-2a [4a^2 - 5ab - 18b]$
 $-8a^2 + 10ab + 36ab$
- C $-2a [4a^2 - 8ab - 3ab - 18b]$
 $-2a [4a^2 - 11ab - 18b]$
 $-8a^3 + 22a^2b + 36ab$
- D $-2a [4a^2 + 8ab + 3ab + 18b]$
 $-2a [4a^2 + 11ab + 18b]$
 $-8a^3 - 22a^2b - 36ab$

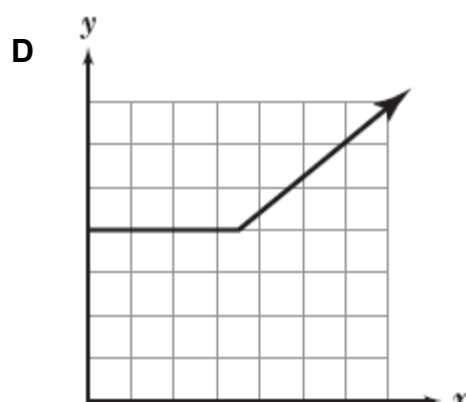
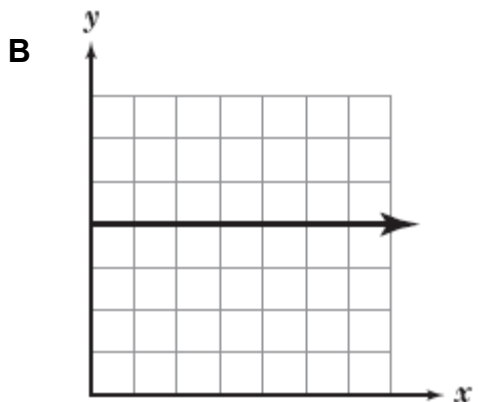
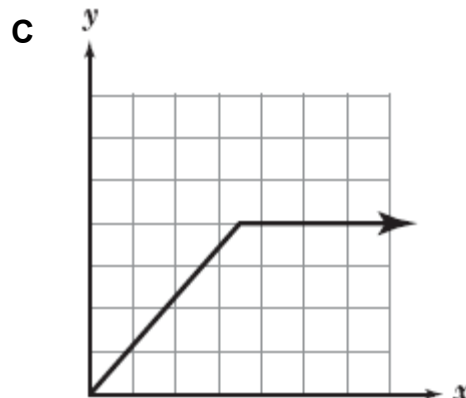
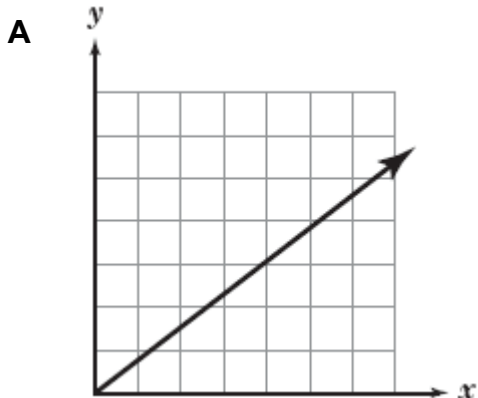
- 37** The statements below are out of order.

W: If blitz, then kerd.
 X: If mot, then det.
 Y: If kerd, then mot.
 Z: If toc, then blitz.

Which list shows the *if...then* statements in logical order?

- A $W \rightarrow Z \rightarrow X \rightarrow Y$
- B $Z \rightarrow W \rightarrow Y \rightarrow X$
- C $W \rightarrow Y \rightarrow X \rightarrow Z$
- D $Z \rightarrow X \rightarrow Y \rightarrow W$

- 38** Janelle's cell phone company charges a monthly fixed rate for the first 1,000 minutes, and then charges for each additional minute. Which graph **best** represents Janelle's monthly cell phone plan?



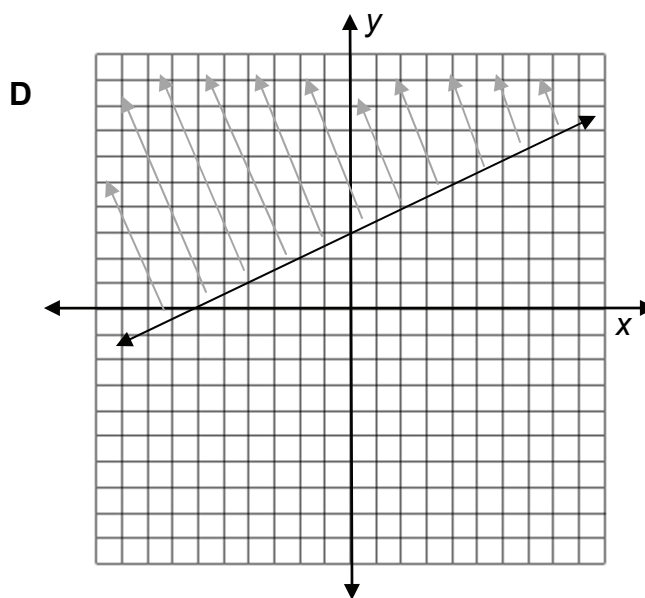
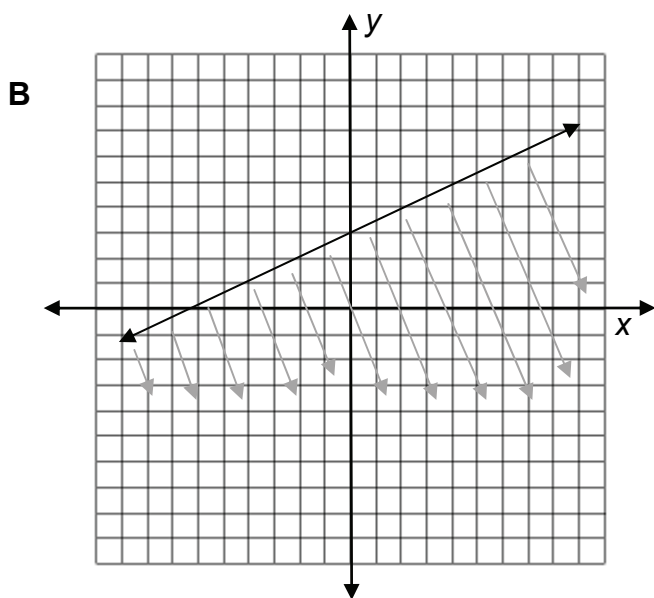
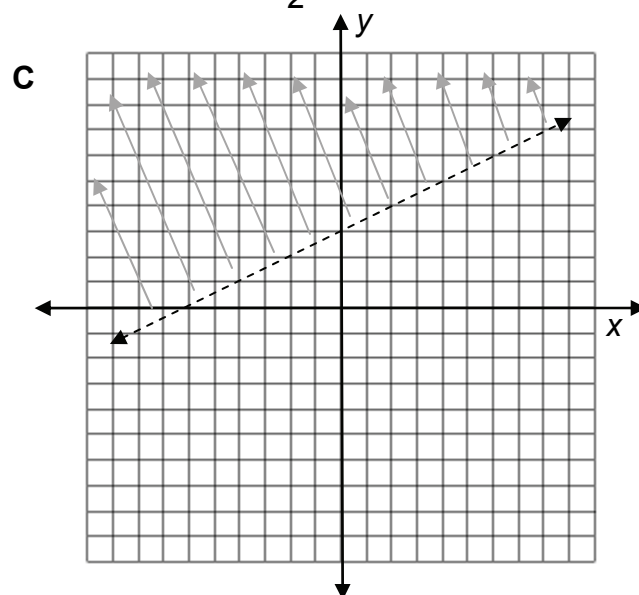
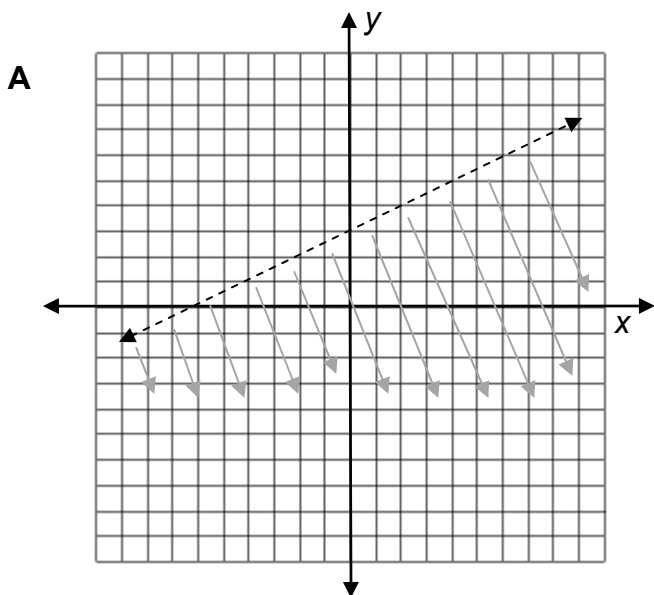
- 39** What are the y-intercept and the slope of the graph of the following equation?

$$-2x + 4y = 8$$

- A** y-intercept: 8
slope: -2
- B** y-intercept: 8
slope: 2
- C** y-intercept: 2
slope: $-\frac{1}{2}$
- D** y-intercept: 2
slope: $\frac{1}{2}$

Go On ►

40 Which of the following **best** represents the graph of the inequality $y < \frac{1}{2}x + 3$?



41 Which pair of figures is structurally similar?

- A cone and cube
- B cone and sphere
- C cone and rectangular prism
- D cone and triangular pyramid

42 Points $(-1, 8)$ and $(3, 5)$ lie on a coordinate plane. What is the distance between the two points?

- A $\sqrt{7}$
- B 5
- C $\sqrt{85}$
- D 25



AIMS HS Mathematics Sample Test Answer Key

The answer key below shows you the Strand, Concept, and Performance Objective that each item is addressing. This will help you to identify which Concepts from the AZ Academic Mathematics Standards that you may need to study more.

1	3.1.1	C
2	2.1.5	B
3	3.2.2	A
4	3.4.3	C
5	2.3.2	D
6	4.4.3	D
7	2.1.5	D
8	3.1.3	B
9	1.3.1	C
10	3.3.11	C
11	4.2.4	A
12	4.4.3	B
13	1.1.3	D
14	2.3.3	B

15	2.2.3	C
16	5.2.9	C
17	3.3.2	A
18	4.3.1	A
19	2.2.2	C
20	4.4.5	D
21	4.1.9	D
22	4.1.1	B
23	4.1.1	C
24	3.2.2	C
25	4.3.8	B
26	3.3.5	B
27	5.2.8	D
28	4.2.2	D

29	3.3.8	B
30	3.3.11	C
31	3.3.14	C
32	3.3.4	A
33	4.1.1	C
34	4.1.8	B
35	5.2.9	D
36	5.1.1	C
37	5.2.10	B
38	3.2.1	D
39	3.4.1	D
40	4.3.5	A
41	5.2.7	D
42	4.3.3	B

AIMS HS Mathematics Think-Throughs & Practice Applications

The problems on the following pages are from the sample test you just finished. They have been worked out for you to show the thought process behind finding the answers.

As you go through them, see how your thoughts compare to the ones given. Not every problem from the sample test will be shown in this same manner.

The number for each problem matches the same number that it is in the sample test. This way, if you got the problem incorrect you can compare your answers and go back to see what you may have done differently.

Then, after each Think-Through problem, you will find two more problems to apply what you just learned from the Think-Through problems. These will be very similar to the Think-Through problem. They are also testing the same academic performance objective. This will give you even more practice to think through your own problem solving process.

As you read through the solution process of the problems, you may notice that some of the words are *italicized*. This indicates some mathematics terms that would be helpful to know.

After the two application problems, there will be a Summary Statement which explains the basic concept that the problems are testing. This will help you to understand which concepts you may need more work on or which concepts you may have mastered.

13 What is the distance between -4 and 3 ?

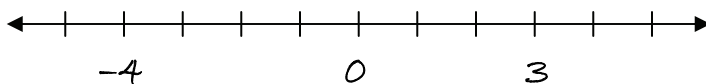
- A** -7
- B** -1
- C** 1
- D** 7

When I see that the question asks for *distance*, I know it is asking how far apart the numbers are. There are a couple of ways that I can solve this problem.

First, I can solve this problem using one of the rules that I have learned: *the distance between two numbers is the absolute value of their difference*.

When I write that out, I get $|-4 - 3|$. This then equals $|-7|$. I know that absolute value is then simply 7 . I also know that the answer cannot be negative because I am looking for the distance from one point to another, which must be positive. So, since the answer is 7 , I would choose answer choice **D**.

Another way that I could solve this problem is that I can think about the numbers on a number line. I need to draw a number line and locate the two points on it.



Then, I can count how many spaces are between -4 and 3 .



I counted 7 spaces. Therefore, the distance between -4 and 3 is 7 , which again is answer choice **D**.

13a What is the distance between 2 and -6 ?

- A** -8
- B** -4
- C** 4
- D** 8

13b What is the distance between -4 and -10 ?

- A** -14
- B** -6
- C** 6
- D** 14

Summary Statement:

These problems involve expressing that the distance between two numbers is the absolute value of their difference. The absolute value is a number's distance from zero on a number line.

- 15** Which pair of events is dependent?
- A** roll a fair cube; flip a coin
 - B** flip a coin; flip the coin again
 - C** select a card from a deck, then keep it; select another card
 - D** select a card from a deck, then put it back; select another card

The question is asking which pair of events is *dependent*. The key word is *dependent*. I know that means that one thing relies on another. So, *dependent* events are when one takes place, it will affect the probability of the second event. Since there is no real problem to work out, I have to read each answer choice and decide; in which situation does the first listed event affect the outcome of the second listed event?

A roll a fair cube; flip a coin

For choice A, I can already see that these two events are *independent* of each other because they are completely separate. Rolling a cube and flipping a coin have no effect on each other.

B flip a coin; flip the coin again

For choice B, I flip a coin and then flip it again. The result of one coin flip has no effect on a second flip, or on a 99th flip for that matter. These events are *independent*.

C select a card from a deck, then keep it; select another card

For choice C, first I take a card from a deck, keep it, and then take another card. In this case, the outcome of the second event relies on the first one. Since I kept the first card I took, when I select another one, I can no longer pick the same card. There are fewer cards to choose from when I select the second card. This means that these events are *dependent* on each other. This looks like the correct answer, but I will check the last answer choice to be sure.

D select a card from a deck, then put it back; select another card

If I first take a card from a deck, then I put it back and take another card, the second event is really not affected by the first one. I still can choose from any card in the deck since I put back the first card I took.

After carefully going through each answer choice, I see that the correct answer is choice **C**.

15a Which pair of events is dependent?

- A** select a marble from a bag and keep it; select another marble
- B** select a marble from a bag and keep it; flip a coin
- C** roll a fair cube; roll the fair cube again
- D** flip a coin; flip the coin again

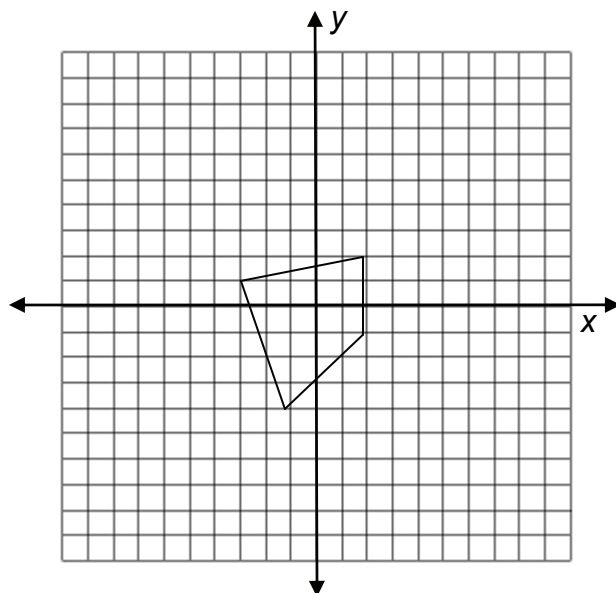
15b Which pair of events is independent?

- A** select a card from a deck and keep it; select another card
- B** select a marble from a bag and keep it; select another marble
- C** select a marble from a bag and put it back; select another marble
- D** select a card from a deck and put it on a table; select another card

Summary Statement:

These problems look at using simulations that model situations involving independent and dependent events. With *dependent* events, the outcome of the second event is affected by the first event. With *independent* events, neither event relies on the other.

- 18** The coordinates $(2, 2)$ and $(-3, 1)$ are two of the vertices of the figure on the coordinate plane.



What are the coordinates of the midpoint of the two vertices?

- A** $\left(-\frac{1}{2}, \frac{3}{2}\right)$
- B** $\left(-\frac{3}{2}, \frac{1}{2}\right)$
- C** $\left(\frac{1}{2}, \frac{3}{2}\right)$
- D** $\left(\frac{3}{2}, \frac{1}{2}\right)$

This question is asking me to find the *midpoint* of a line segment. *Midpoint* means the middle point of a line, or of two coordinates in a coordinate plane. I look at the graph and see the figure, but that really has nothing to do with helping me to solve for midpoint. It does help me to visualize the line.

As soon as I see the given coordinates and the word *midpoint*, I know that I am going to need a formula for the solution. When I flip to the HS AIMS Reference Sheet, I see the different formulas that I can use. I go to the section for Coordinate Geometry, since I have given coordinates, and I look for the one that has to do with *midpoint*. The formula is:

$$\text{Midpoint between two points} = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

In order to solve for *midpoint*, I need to plug the values given into the midpoint formula. This formula is asking me to add the values of like coordinates and then divide that answer by 2. This also looks like I am averaging like coordinates to make new coordinates for the *midpoint*.

(continued on page 23)

I see that in the formula, I am going to be adding the x values together and the y values together. The coordinates given are $(2, 2)$ and $(-3, 1)$.

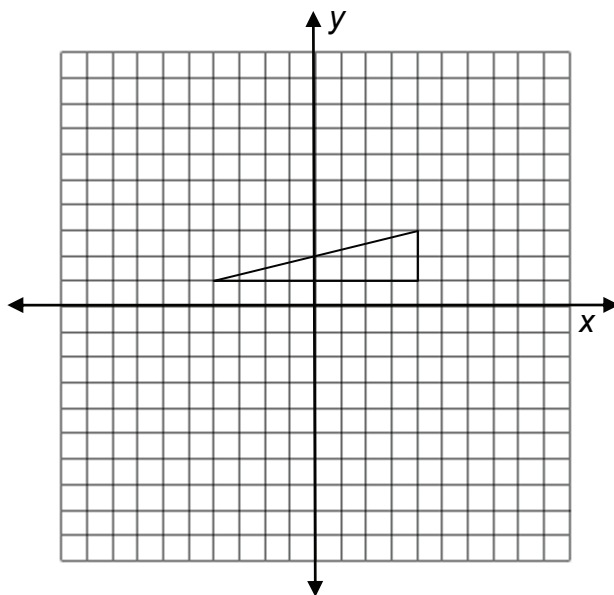
$$\begin{array}{cccc} & \uparrow & \uparrow & & \uparrow & \uparrow \\ & x_1 & y_1 & & x_2 & y_2 \end{array}$$

Now, when I plug the coordinate values into the formula, I get:

$$\begin{aligned} \text{Midpoint between two points} &= \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) \\ &= \left(\frac{2 + (-3)}{2}, \frac{2 + 1}{2} \right) \\ &= \left(\frac{-1}{2}, \frac{3}{2} \right) \end{aligned}$$

I see that $\left(-\frac{1}{2}, \frac{3}{2}\right)$ are the coordinates of the midpoint, which is answer choice **A**.

- 18a** The coordinates $(-4, 1)$ and $(4, 3)$ are two vertices of a right triangle on a coordinate plane.



What are the coordinates of the midpoint of the two vertices?

- A** $(4, 1)$
- B** $(0, 2)$
- C** $(2, 0)$
- D** $(1, 4)$

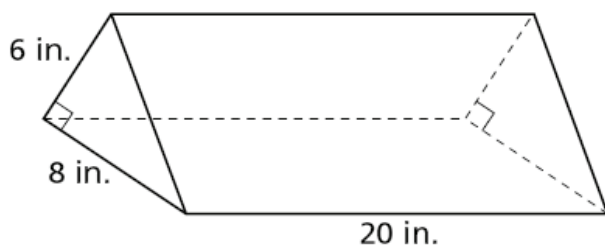
- 18b** Coordinates $A(-2, 4)$ and $B(-4, 1)$ lie on a coordinate plane. What is the midpoint of line segment AB ?

- A** $\left(\frac{5}{2}, -3\right)$
- B** $\left(-\frac{5}{2}, 3\right)$
- C** $\left(-3, \frac{5}{2}\right)$
- D** $\left(3, \frac{5}{2}\right)$

Summary Statement:

These problems involve determining how to find the midpoint between two points in the coordinate plane. It is important to also understand how to use the midpoint formula.

- 20 Look at the 3-dimensional figure.



What is the total surface area of the figure?

- A 328 in²
- B 480 in²
- C 504 in²
- D 528 in²

I see that the question is asking for *total surface area*. I know that *surface area* is the area of each face of the figure added together.

It looks like I have a couple of ways to solve this problem: I can use a formula to calculate the total surface area, or I can draw a net of the figure, calculate the area of each shape, and then add all areas together.

Since I have the HS AIMS Reference Sheet, I will use the formula in order to find the *surface area*. When I look at the reference sheet, I see it on the first page, labeled *Surface Area*. But, now I need to look further under each 3-dimensional solid that is listed.

Since I see this figure has a right triangle for its base (I can tell because of the 90° angle mark illustrated on the figure), I know this is a right prism.

The formula for *surface area* for a right prism is **$SA = 2B + Ph$** .

The key at the top of the reference sheet tells me that **B** is the area of the base, **P** is the perimeter of the base, and **h** is the height of the figure.

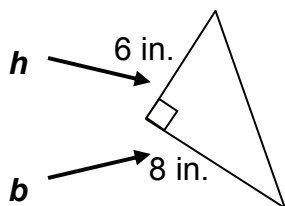
Now that I know the formula, I will look to see what values are shown on the figure so I can substitute them into the formula.

It looks like I do not have the area of the triangular base (**B**) or the perimeter (**P**). I know the height (**h**) is 20in because that is the distance between the two parallel bases. It helps me to think about the prism as if it were standing up, on the triangular base.

(continued on page 26)

Since **B** is the area of the base, I will find that first. In order to find the area of the right triangle, I need that formula also. On the reference sheet under Formulas for Area, I see for the area of a triangle I can use $A = \frac{1}{2}bh$.

I will substitute the values of the right triangle into this first formula to find **B**.



$$A = \frac{1}{2}bh \quad A = \frac{1}{2}(8)(6) = \frac{1}{2}(48) = 24$$

The area of the triangle is 24 in. Now I have the value for **B**. So far I have two values I can substitute into my original formula for the total surface area: $h = 20$ and $B = 24$.

$$SA = 2B + Ph$$

$$SA = 2(24) + P(20).$$

I still need the perimeter (**P**) of the base. I know that perimeter is the distance around the base of the figure. I know that I have the measures of two sides of the triangle, 6 in. and 8 in., but I do not have the last side. Since I know this is a right triangle, I know that I can figure out the value for the missing side using the Pythagorean Theorem, which is also on the reference sheet: $a^2 + b^2 = c^2$, where **a** is the height, **b** is the base, and **c** is the hypotenuse.

$$a = 6, b = 8, c = ?$$

$$6^2 + 8^2 = c^2$$

$$36 + 64 = c^2$$

$$100 = c^2$$

$$\sqrt{100} = \sqrt{c^2}$$

$$c = 10$$

Now I have all three measures for the sides of the base: **6**, **8**, and **10**. Since I know for perimeter I need to add all sides together, I get $6 + 8 + 10 = 24$. So, the value for **P** is **24**.

I now have all values for the original formula and I can substitute: $B = 24$, $P = 24$, and $h = 20$.

$$SA = 2B + Ph$$

$$SA = 2(24) + 24(20)$$

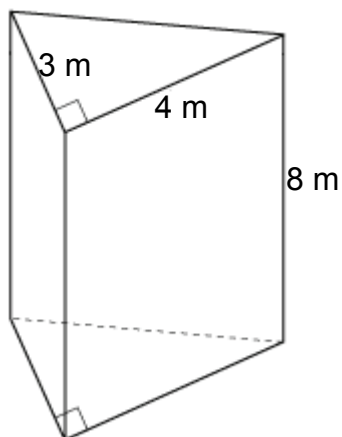
$$SA = 48 + 480$$

$$SA = 528 \text{ in}^2$$

I calculated 528 in^2 , which is answer choice **D**.

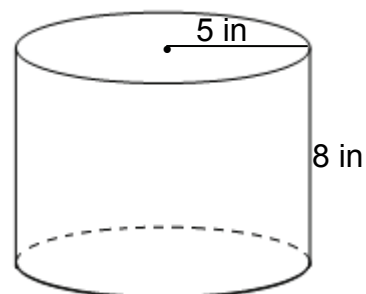
Maybe next time I will try the other way of calculating total surface area using the net method.

20a What is the total surface area of the triangular prism below?



- A 48 m^2
- B 68 m^2
- C 108 m^2
- D 120 m^2

20b Look at the cylinder.



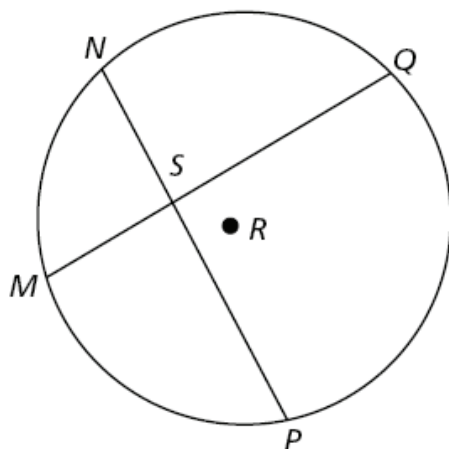
What is the total surface area?

- A $65\pi \text{ in}^2$
- B $90\pi \text{ in}^2$
- C $105\pi \text{ in}^2$
- D $130\pi \text{ in}^2$

Summary Statement:

These problems involve calculating the surface area and volume of 3-dimensional figures and solving for missing measures. All necessary formulas can be found on the reference sheet.

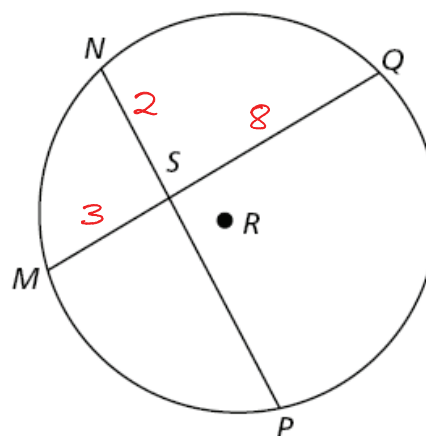
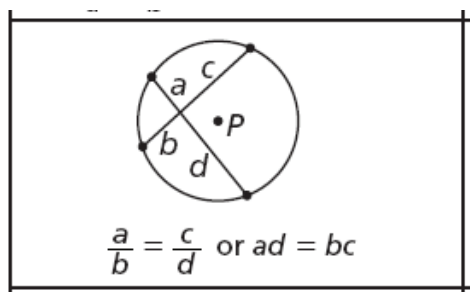
22 Chords \overline{NP} and \overline{MQ} intersect at point S in circle R .



If $MS = 3$, $NS = 2$, and $SQ = 8$, what is the length of \overline{SP} ?

- A** 9
- B** 12
- C** 14
- D** 24

Everything in this problem has to do with properties of circles. The first thing I will do is look at the AIMS HS Mathematics Reference Sheet. I will look on the 2nd page where the images match the one for this problem. The first one in the second row looks like the one in this problem.



I will make a key that will match the properties in the reference image to my image.

<u>Reference Image</u>	<u>My Image</u>
a	$NS = 2$
b	$MS = 3$
c	$SQ = 8$
d	$SP = ?$
$ad = bc$	$NS (SP) = MS (SQ)$

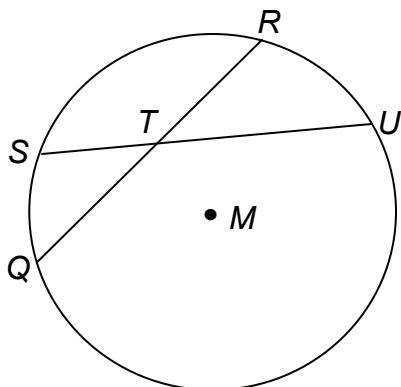
(continued on page 29)

When I look back at the original question, “If $MS = 3$, $NS = 2$, and $SQ = 8$, what is the length of \overline{SP} ?” I see that I have 3 out of the 4 values and can solve for the missing value since I made that reference key. I can substitute what I know into the equation.

$$\begin{array}{r}
 NS (SP) = MS (SQ) \quad 2 (SP) = 3 (8) \\
 2 (SP) = 24 \\
 \hline
 \cancel{2} (SP) = \cancel{24} \\
 \cancel{2} \quad \quad 2 \\
 SP = 12
 \end{array}$$

After all calculations, I found that SP is 12, which is answer choice **B**.

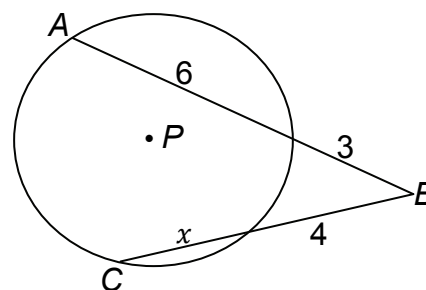
- 22a** Chords RQ and SU intersect at point T in circle M .



If $RT = 2$, $TQ = 6$, and $UT = 3$, what is the length of ST ?

- A 2
- B 3
- C 4
- D 5

- 22b** Line segments AB and CB intersect outside of circle P as shown below.



What is the value of x ?

- A 2
- B $\frac{11}{4}$
- C $\frac{9}{2}$
- D 8

Summary Statement:

These problems involve using the basic properties of a circle to prove basic theorems and solve problems. The properties of a circle are relationships between angles, radii, intercepted arcs, chords, tangents, and secants.

24 Which table represents y as a function of x ?

A

x	1	2	3	2	1
y	1	2	3	4	5

B

x	4	5	4	3	2
y	-6	-5	-4	-3	-2

C

x	8	7	6	5	4
y	-1	2	-1	2	-1

D

x	3	4	3	2	3
y	0	1	2	1	3

The question is asking which of the tables given shows a *function*. The first thing I need to remember is the meaning of *function*.

Since the question states that y is a function of x , this means y depends on x . So, for every value of x in a *function*, there can only be one value for y .

If I look at each of the values shown for x , I notice...

- For choice A, I see that when x is 1, y is 1, but also when x is 1, y is 5. Since that is two different values for y when the x is the same, this table does **not** show a function.
- For choice B, I see that when x is 4, y is -6, but also when x is 4, y is -4. Since that is two different values for y when the x is the same, this table does **not** show a function.

x	1	2	3	2	1
y	1	2	3	4	5

x	4	5	4	3	2
y	-6	-5	-4	-3	-2

(continued on page 32)

- For choice C, I see that all x values are different, and for each x value there is only one y value. Therefore, this table **does** show a function.
- For choice D, I see that when x is 3, y is 0 and 2 and 3. Since there **cannot** be three different values for y , this table does **not** show a function.

x	8	7	6	5	4
y	-1	2	-1	2	-1

x	3	4	3	2	3
y	0	1	2	1	3

After looking at all of the answer choices, I see that the only table which shows one y value for every x value is table **C**.

Another way that I could solve this problem is by using the *vertical line test*.

- First, I would graph the given values of x and y .
- Then, after graphing them and connect the points, I would look at what the points create.
- Next what I would do is imagine a vertical line sliding across the image (or, use my pencil and slide it over the image).
- Finally, if more than one point of the image falls on the vertical line, then that image does not represent a function.

No two points are on the vertical line at one time. This represents a function.

No two points are on the vertical line at one time. This represents a function.

No two points are on the vertical line at one time. This represents a function.

Two points are on the vertical line at one time. This does **not** represent a function.

24a Which table represents y as a function of x ?

A

x	-2	-1	0	-1	3
y	2	3	4	6	7

C

x	0	1	0	-1	3
y	2	4	6	8	8

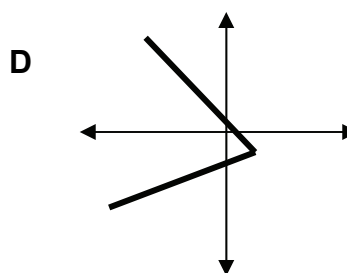
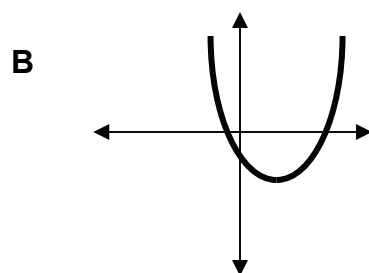
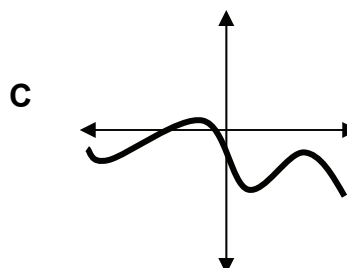
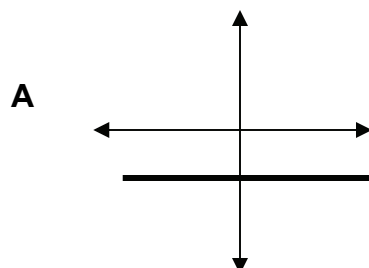
B

x	0	1	2	3	5
y	4	6	4	6	8

D

x	-4	-2	0	-2	3
y	-6	-4	0	4	9

24b Which graph does **not** represent a function?



Summary Statement:

These problems involve determining if a relationship represented by an equation, graph, table, description, or set of ordered pairs represents a function.

26 What are the values of x in the equation shown?

$$2|3x - 4| = 20$$

A $-\frac{14}{3}, \frac{14}{3}$

B $-2, \frac{14}{3}$

C $-\frac{14}{3}, 2$

D $-4, \frac{8}{3}$

In this problem, I see that I need to solve for x . And, when I see the vertical lines in the equation, I also know that I will be dealing with *absolute value*. I will just keep that in mind.

When I look at the given equation, I know that in order to solve for x , I need to get x by itself. I need to get rid of the 2 by performing the inverse operation.

$$2|3x - 4| = 20$$

The first step is to divide everything on the left side of the equation (equals sign) by 2. And, what I do to one side I must do to the other.

$$\frac{\cancel{2}|3x - 4|}{\cancel{2}} = \frac{20}{2}$$

Now I am still left with the absolute value brackets.  $|3x - 4| = 10$

Because the left side of the equation calls for *absolute value*, I know that means the value of the expression in the absolute value brackets can be positive or negative. I need to work this two ways because of that fact.

I need to create two equations: one will be set equal to +10, and one will be set equal to -10. I will solve both equations for x using Inverse operations.

$$\begin{array}{r} 3x - 4 = 10 \\ +4 \quad +4 \end{array} \qquad \begin{array}{r} 3x - 4 = -10 \\ +4 \quad +4 \end{array}$$

$$\frac{3x}{3} = \frac{14}{3} \qquad \frac{3x}{3} = \frac{-6}{3}$$

When I finish, I see that x can be $\frac{14}{3}$ and x can be -2 , which is answer choice **B**.

$$x = \frac{14}{3} \quad \text{and} \quad x = -2$$

I could substitute both values back into the original equation to double check my answers.

26a What are the values of x in the equation shown?

$$3|2x + 1| = 45$$

- A $-8, 7$
- B $-23, 22$
- C $-\frac{22}{3}, \frac{22}{3}$
- D $-22, 22$

26b What are the values of x in the equation shown?

$$-4|5x - 2| = -20$$

- A $-\frac{22}{5}, \frac{22}{5}$
- B $-\frac{11}{10}, \frac{11}{10}$
- C $-\frac{18}{5}, \frac{22}{5}$
- D $-\frac{3}{5}, \frac{7}{5}$

Summary Statement:

These problems involve solving linear equations and equations involving absolute value with one variable. Students will need to know the properties of equality in order to solve equations.

39 What are the y-intercept and the slope of the graph of the following equation?

$$-2x + 4y = 8$$

- A** y-intercept: 8
slope: -2
- B** y-intercept: 8
slope: 2
- C** y-intercept: 2
slope: $-\frac{1}{2}$
- D** y-intercept: 2
slope: $\frac{1}{2}$

The question asks for the y-intercept and the slope. I remember that the y-intercept is where the graph of the equation passes through the y-axis, and the slope is how steep the line is, or the rise over the run.

I know that I have seen equations for lines on the HS AIMS Reference Sheet. When I refer to it, I will use the one that is labeled Slope-Intercept Form because I know that form of the equation will tell me the y-intercept and the slope.

y is a y coordinate

Slope-Intercept Form : $y = mx + b$

m is the slope

x is an x coordinate

b is the point where the line crosses the y-axis (y-intercept)

I will take the given equation and work through it to make it look like the slope-intercept form. This basically means I am solving for y.

$$\begin{array}{r}
 -2x + 4y = 8 \\
 +2x \qquad +2x \\
 \hline
 4y = 2x + 8 \\
 \frac{4y}{4} = \frac{2x + 8}{4} \\
 y = \frac{1x + 2}{2}
 \end{array}$$

(continued on page 37)

Now I am left with $y = \frac{1}{2}x + 2$. When I look again at the original question, I need to identify the y-intercept and the slope for the answer.

y is a y coordinate

Slope-Intercept Form : $y = mx + b$

m is the slope

x is an x coordinate

b is the point where the line crosses the y-axis (y-intercept)

So, for the equation of the line $y = \frac{1}{2}x + 2$, the y-intercept is **2** and the slope is $\frac{1}{2}$, which is answer choice **D**.

Another way that I could solve this problem is to create a table of values. I would plug in a value for x and then solve for the y coordinate, using as many points as necessary to determine where the line crosses the y -axis.

I could then plot these coordinates and connect the points to create a line. I could then see where the line crosses the y -axis, and count the rise over the run for the slope.

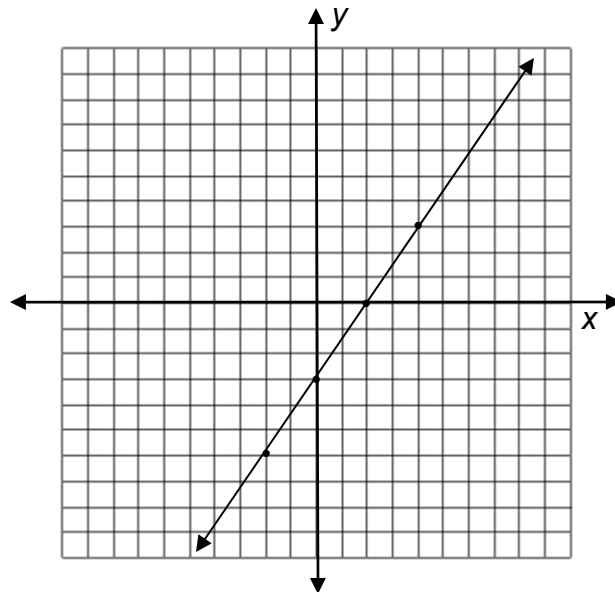
This method can work, but may not be as accurate as using the formula. This would be difficult when fractions are involved.

39a What are the y -intercept and the slope of the graph of the following equation?

$$3x + 4y = 12$$

- A** y -intercept: 3
slope: $\frac{3}{4}$
- B** y -intercept: 3
slope: $-\frac{3}{4}$
- C** y -intercept: -3
slope: $\frac{4}{3}$
- D** y -intercept: -3
slope: $-\frac{4}{3}$

39b What are the y -intercept and the slope of the graph below?



- A** y -intercept: 3
slope: $\frac{2}{3}$
- B** y -intercept: 3
slope: $-\frac{3}{2}$
- C** y -intercept: -3
slope: $\frac{3}{2}$
- D** y -intercept: -3
slope: $-\frac{2}{3}$

Summary Statement:

These problems involve determining the slope and intercepts of the graph of linear functions. Students must also realize that slope is interpreted as a constant rate of change.

AIMS HS Mathematics Practice Applications Answer Key

The answer key below is for the Practice Applications. Included is the Strand, Concept, and Performance Objective that each item is addressing. This will help you to identify which Concepts from the AZ Academic Mathematics Standards that you may need to study more.

Practice Applications Answer Key

Number	13	15	18	20	22	24	26	39
PO	1.1.3	2.2.3	4.3.1	4.4.5	4.1.1	3.2.2	3.3.5	3.4.1
a	D	A	B	C	C	B	A	B
b	C	C	C	D	B	D	D	C