1 A man who is 5 feet 9 inches tall casts a shadow of 8 feet 6 inches. Assuming that he is standing perpendicular to the ground, what is the angle of elevation from the end of the shadow

Key: 1

MeasuresCCLS: G-SRT.C

Mathematical Practice: 4

Commentary: This question measures G-SRT.C because students are required to find the angle of elevation using right triangle trigonometry.

Rationale: 2 S W L R Q L V F R U U H F W 7 K H P D Q ¶ V K H L J K W L Q F K H V and the shadow length, 102 inches, is adjacent to the angle of elevation. Therefore, tangent must be used to find the angle of elevation.

$\tan x = \frac{69}{102}$

$x = \tan^{-1}\left(\frac{69}{102}\right)$

$x = 34.07719528$

Angle of elevation is 34.1°

or

$\tan x = \frac{69}{102}$

$x = \arctan\left(\frac{69}{102}\right)$

$x = 34.07719528$

Angle of elevation is 34.1°

3 The line $y = 2x - 4$ is dilated by a scale factor of $\frac{3}{2}$ and centered at the origin. Which equation represents the image of the line after the dilation?

(1) $y = 2x - 4$
(2) $y = 2x - 6$
(3) $y = 3x - 4$
(4) $y = 3x - 6$

Key: 2

MeasuresCCLS: G-SRT.A

Mathematical Practice: 1

Commentary: This question measures G-SRT.A because students are required to dilate a line not passing through the center of dilation.

Rationale: Option 2 is correct. The line $y = 2x - 4$ does not pass through the center of dilation, so the dilated line will be distinct from $y = 2x - 4$. Since a dilation preserves parallelism, the line $y = 2x - 4$ and its image will be parallel, with slopes of 2. To obtain the y-intercept of the dilated line, the scale factor of the dilation, $\frac{3}{2}$, can be applied to the y-intercept, $(0, -4)$, therefore, $(0 \cdot \frac{3}{2}, -4 \cdot \frac{3}{2})$ or $(0, -6)$. So the equation of the dilated line is $y = 2x - 6$.

4 In the diagram below, the circle shown has radius 10. Angle B intercepts an arc with a length of π.

What is the measure of angle B, in radians?

(1) π

(2) 2π

(3) $\frac{\pi}{5}$

Key: 3

MeasuresCCLS: G-C.B

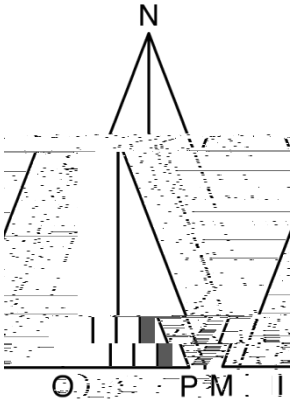
Mathematical Practice: 1

Commentary: This question measures G-C.B because students are required to use the fact that the length of the arc intercepted by an angle is proportional to the radius.

Rationale: Option 3 is correct.

$$s = r\theta$$

5 In isosceles $\triangle MNP$, line segment NO bisects vertex $\angle MNP$, as shown below. If $MP = 16$, find the length of $\overline{MO}$ and explain your answer.



6 A contractor needs to purchase 500 bricks. The dimensions of each brick are 5.1 cm by 10.2 cm by 20.3 cm, and the density of each brick is 1920 kg/m^3

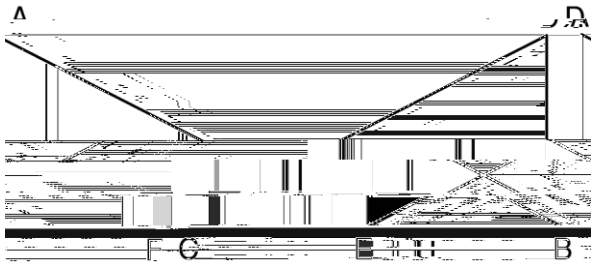
Key: See Rationale below.

MeasuresCCLS: G-SRT.C

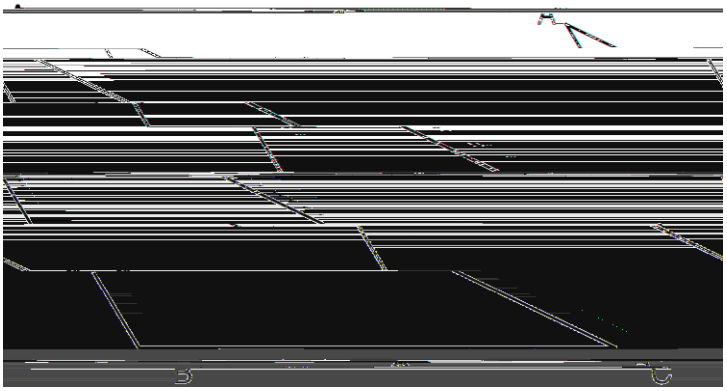
Mathematical Practice: 7

Commentary: This question measures G-SRT.C because students are required to apply their

8 Given right triangles ABC and DEF where C and F are right angles, $\overline{AC} \cong \overline{DF}$ and $\overline{CB} \cong \overline{FE}$. Describe a precise sequence of rigid motions which would show $\triangle ABC \cong \triangle DEF$.



9 Using a compass and straightedge, construct an altitude of triangle ABC below.
[Leave all construction marks.]



Key: See Rationale below.

MeasuresCCLS: G-CO.D

Mathematical Practice: 5,6

Commentary: This question measures G

Rubric:

[2] A correct construction is drawn showing all appropriate arcs, and the altitude is drawn.

[1] Appropriate construction arcs are drawn, but one construction error is made, such as not drawing in the altitude.

10

Key: See Rationale below.

MeasuresCCLS: G-CO.C

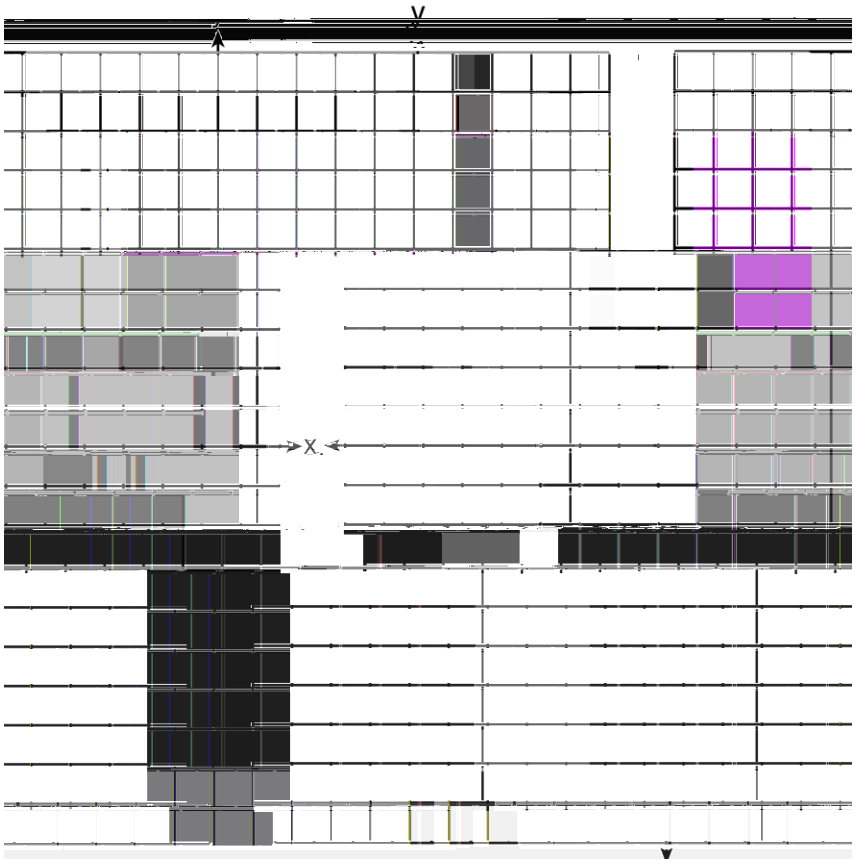
Mathematical Practice: 3

Commentary: This question measures G-CO.C because students are required to prove the theorem: the sum of the exterior angles of a triangle equals 360°.

Rationale: As the sum of the measures of the angles of a triangle is 180°, $m\angle ABC + m\angle BCA + m\angle CAB = 180°$. Each interior angle of the triangle and its exterior angle form a linear pair. Linear pairs are supplementary, so $m\angle ABC + m\angle FBC = 180°$, $m\angle BCA + m\angle DCA = 180°$, and $m\angle CAB + m\angle EAB = 180°$. By addition, the sum of these linear pairs is 540°. When the angle measures of the triangle are subtracted from this sum, the

11 In rhombus $MATH$, the coordinates of the endpoints of the diagonal $\overline{MT}$ are $M(0,-1)$ and $T(4,6)$. Write an equation of the line that contains diagonal $\overline{AH}$. [Use of the set of axes below is optional.]

Using the given information, explain how you know that your line contains diagonal $\overline{AH}$.



Key: See Rationale below.

MeasuresCCLS: G-GPE.B

Mathematical Practice: 1,3

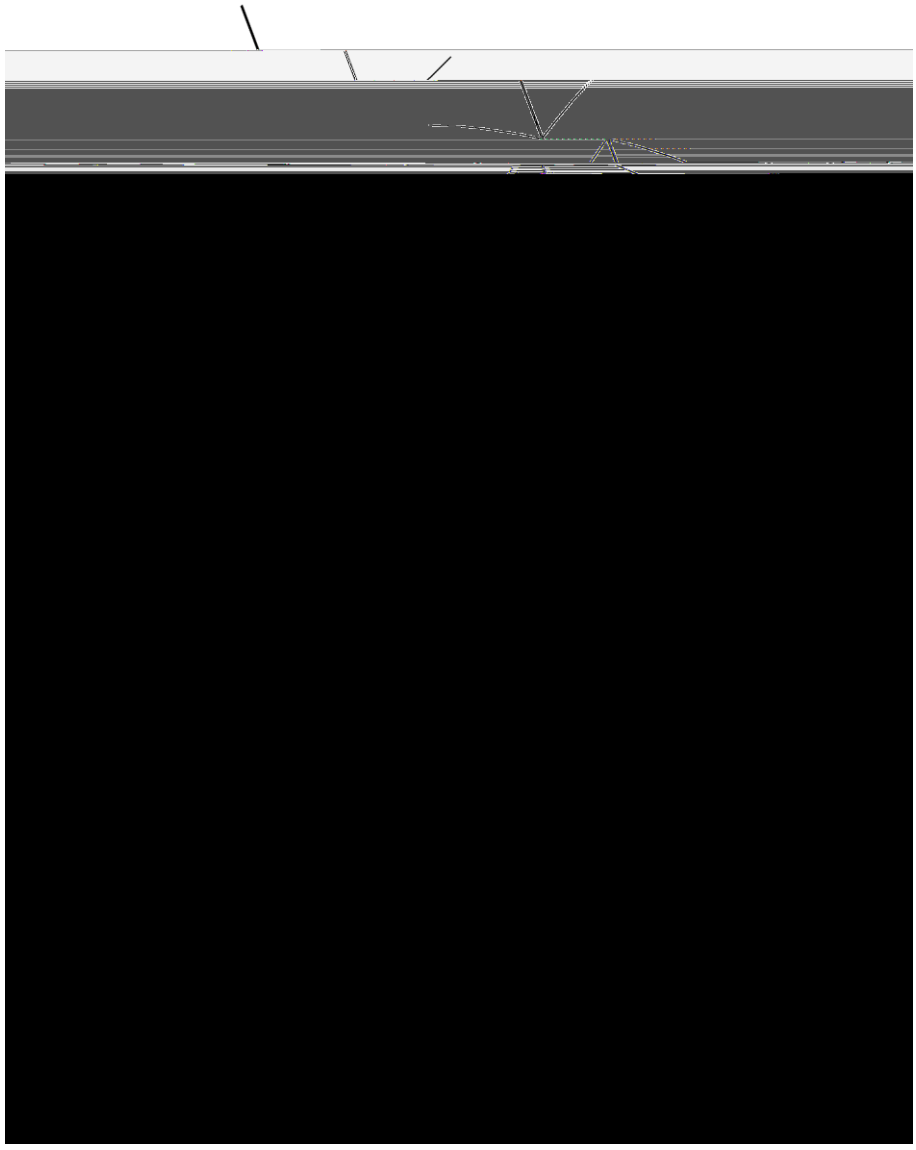
Commentary: This question measures G-GPE.B because students are required to use the slope criteria for perpendicular lines to solve a geometric problem.

Key: See Rationale below.

MeasuresCCLS: G-CO.D

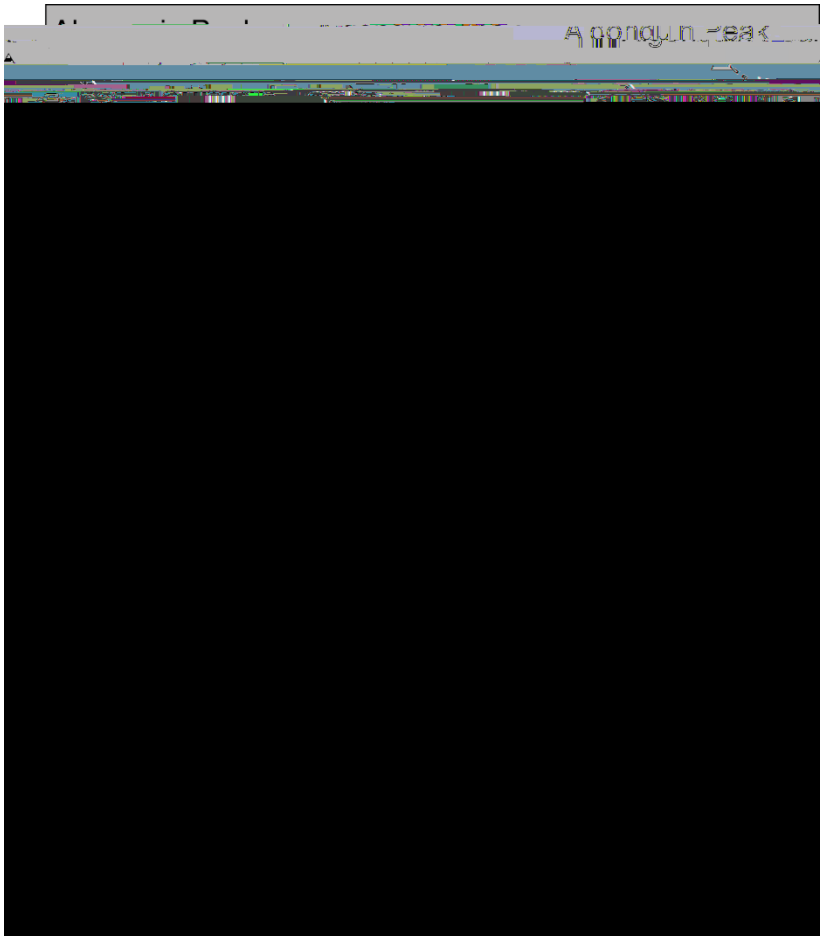
Commentary: This question measures G-CO.D because students are required to construct an inscribed square in a circle.

Rationale:



Since the square is inscribed, each vertex of the square is on the circle and the diagonals of the square are diameters of the circle, therefore, each angle of the square is an inscribed angle in the circle that intercepts the circle at the endpoints of the diameters. Each angle of the square, which is an inscribed angle, measures 90 degrees. Therefore, the measure of the arc intercepted by two adjacent sides of the square is 180 degrees E H F D X V H L W ¶ V W Z L F H W K H P H D V X U H R I L W V L Q V F U L E

13 The map below shows the three tallest mountain peaks in New York State: Mount Marcy, Algonquin Peak, and Mount Haystack. Mount Haystack, the shortest peak, is 4960 feet tall. Surveyors have determined the horizontal distance between Mount Haystack and Mount Marcy is 6336 feet and the horizontal distance between Mount Marcy and Algonquin Peak is 20,493 feet.



The angle of depression from the peak of Mount Marcy to the peak of Mount Haystack is 3.47 degrees. The angle of elevation from the peak of Algonquin Peak to the peak of Mount Marcy is 0.64 degrees. What are the heights, to the nearest foot, of Mount Marcy and Algonquin Peak? Justify your answer.

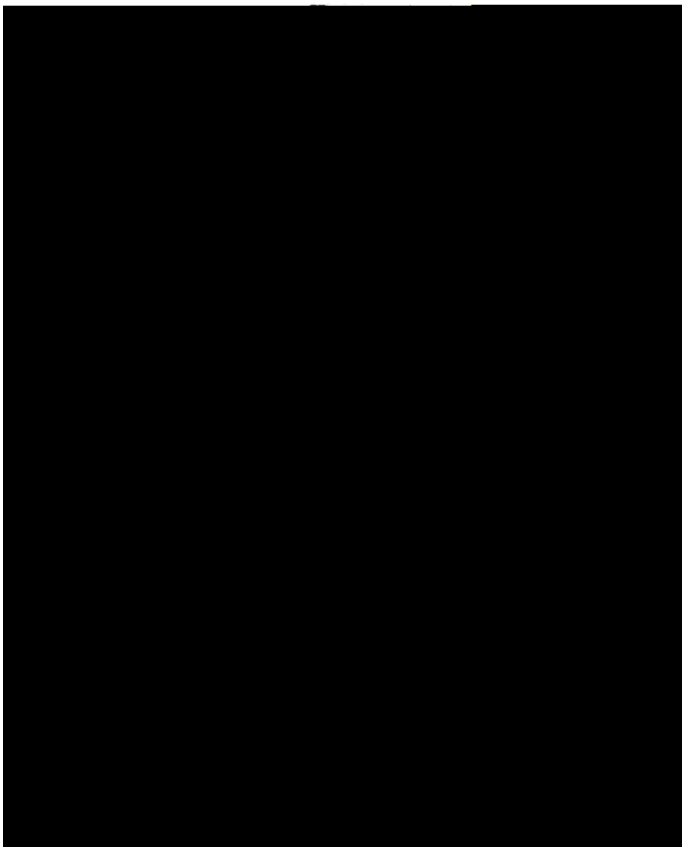
Key: See Rationale below

Measures CCLS: G-SRT.C

Mathematical Practice: 4

Commentary: This question measures G-SRT.C because students are required to use trigonometric ratios to solve applied problems.

Rationale:



$\tan 3.47 = \frac{x}{6336}$

$x = 6336(\tan 3.47)$

Mount Marcy = 4960 + 6336(tan 3.47)

Mount Marcy = 5344

$\tan 0.64 = \frac{n}{20,493}$

$n = 20,493(\tan 0.64)$

Algonquin Peak = 5344 − 20,493(tan 0.64)

Algonquin Peak = 5115

Rubric:

[6] 5344, the height of Mount Marcy, and 5115, the height of Algonquin, and correct work is shown.

[5] Appropriate work is shown, but one computational or rounding error is made.

[4] Appropriate work is shown, but two computational or rounding errors are made.
or
[4] Appropriate work is shown, but one conceptual error is made.

[3] Appropriate work is shown, but three or more computational or rounding errors are made.
or

[3] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.

or

[3] Appropriate work is shown to find 5344, but no further correct work is shown.

[2] Appropriate work is shown, but two conceptual errors are made.

or

[2] Appropriate work is shown to find 384 or 229, the height differences between Mount Marcy and other two mountains, but no further correct work is shown.

[1] $\tan 3.47 = \frac{x}{6336}$ or $\tan 0.64 = \frac{n}{20,493}$ is written, but no further correct work is shown.

or

[1] Correct diagrams are drawn and labeled showing the height relationships between Mount Marcy and Mount Haystack and Algonquin Peak, but no further correct work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.