Unit 1 Assessment • Similarity, Congruence, and Proofs Answer Key

Item	Answer	Common Core Georgia Performance Standards	Level*	Common Core Coach Lesson(s)
1	B	MCC9-12.G.SRT.2	1	Lesson 1
2	A	MCC9-12.G.SRT.3, MP7	1	Lesson 2
3	C	MCC9-12.G.CO.9	1	Lesson 5
4	D	MCC9-12.G.SRT.5, MP2	2	Lesson 2
5	D	MCC9-12.G.SRT.1a	2	Lesson 1
6	A	MCC9-12.G.CO.7	1	Lesson 4
7	A	MCC9-12.G.CO.11, MP6	2	Lesson 5
8	D	MCC9-12.G.CO.6	2	Lesson 3
9	A	MCC9-12.G.SRT.1b	1	Lesson 1
10	B	MCC9-12.G.CO.10	2	Lesson 5
11	A	MCC9-12.G.SRT.3	2	Lesson 2
12	B	MCC9-12.G.CO.12, MP5	2	Lesson 6
13	A	MCC9-12.G.CO.6	3	Lesson 3
14	C	MCC9-12.G.SRT.4	2	Lesson 2
15	B	MCC9-12.G.SRT.2, MP7	2	Lesson 1
16	C	MCC9-12.G.SRT.1b	2	Lesson 1
17	B	MCC9-12.G.CO.8	2	Lesson 4
18	D	MCC9-12.G.CO.12, MP3	3	Lesson 6
19	A	MCC9-12.G.CO.9	2	Lesson 5
20	A	MCC9-12.G.SRT.5	2	Lesson 2
21	See scoring rubric.	MCC9-12.G.SRT.2, MP3	2	Lesson 1
22	See scoring rubric.	MCC9-12.G.CO.10	3	Lesson 5
23	See scoring rubric.	MCC9-12.G.SRT.4, MP4, MP7	3	Lesson 2
24	See scoring rubric.	MCC9-12.G.CO.11, MP3	3	Lesson 5
25	See scoring rubric.	MCC9-12.G.CO.12, MCC9-12.G.CO.13, MP5	3	Lessons 6, 7

* Levels according to Webb's Depth of Knowledge

21. Willow is correct that the triangles are similar, but her description of the dilation is incorrect. Triangle $P'Q'R'$ is the result of a reduction of $\triangle PQR$, not an enlargement, so the scale factor must be less than 1.

$P(-5, 5) \rightarrow \left(-5 \times \frac{3}{5}, 5 \times \frac{3}{5}\right) \rightarrow P'(-3, 3)$

$Q(0, 5) \rightarrow \left(0 \times \frac{3}{5}, 5 \times \frac{3}{5}\right) \rightarrow Q'(0, 3)$

$R(-5, -5) \rightarrow \left(-5 \times \frac{3}{5}, -5 \times \frac{3}{5}\right) \rightarrow R'(-3, -3)$

Triangle PQR was dilated by a scale factor of $\frac{3}{5}$, not $\frac{5}{3}$, from the origin to produce $\triangle P'Q'R'$.

Use the 2-point rubric below to grade student work.

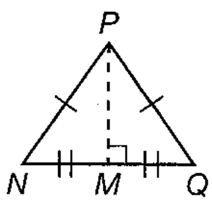
2 Student has shown a complete and correct response.

1 Student correctly states that the triangles are similar and may identify the correct scale factor with no work shown, or may identify an incorrect scale factor with appropriate work containing minor calculation errors.

0 Student has shown little or no understanding of dilations and scale factors.

22. **Since $\overline{PM}$ is a median, point M is the midpoint of $\overline{NQ}$ and $\overline{NM} = \overline{QM}$. I drew marks to show this on the diagram. The diagram shows that $\overline{PN} \cong \overline{PQ}$ and $\overline{NM} \cong \overline{QM}$. $\overline{PM}$ is common to both $\triangle PNM$ and $\triangle PQM$, so the triangles share a third side that is congruent. By the SSS postulate, therefore, $\triangle NPM \cong \triangle QPM$. Corresponding angles of the triangles are congruent, so $\angle N \cong \angle Q$. This proves that the base angles of an isosceles triangle are congruent.**

Possible drawing:



Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student may show a partial understanding of medians, similar triangles, and/or the base angles of an isosceles triangle and of proof.

0 Student has shown little or no understanding of how to prove that the base angles are congruent.

23. A. $\frac{JL}{KL} = \frac{KL}{ML}$

$\frac{c}{a} = \frac{a}{q}$

$a^2 = cq$

B. $\frac{JL}{JK} = \frac{JK}{JM}$

$\frac{c}{b} = \frac{b}{p}$

$b^2 = cp$

C. $a^2 + b^2 = cp + cq = c(p + q)$;

In $\triangle JKL$, $JL = c$ and $JL = p + q$, also. So, $a^2 + b^2 = c(p + q) = c^2$.

So, $a^2 + b^2 = c^2$.

Use the 4-point rubric below to assess student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate understanding of how to prove the Pythagorean theorem, but may have made one or two calculation errors or one or two minor errors in reasoning.

2 Student may demonstrate understanding of the proportional relationship between side lengths in similar triangles but little or no understanding of how to derive the Pythagorean theorem, or student may show an understanding of how to derive the formula but was unable to do so due to major errors in Parts A and/or B.

1 Student may give one or more correct answer(s) with little or no work shown or with work that shows major errors.

0 Student has shown little or no understanding of similar triangles or how to derive the Pythagorean theorem.

24. A. Opposite sides of a parallelogram are congruent and parallel, so opposite sides *QR* and *SP* are congruent and parallel.

B. $\overline{QS}$ is a transversal intersecting parallel segments *QR* and *PS*. So, the alternate interior angles *RQS* and *PSQ* are congruent.

$\overline{RP}$ is a transversal intersecting parallel segments *QR* and *PS*. So, the alternate interior angles *QRP* and *SPR* are congruent.

C. Corresponding angles *RQS* and *PSQ* are congruent, corresponding angles *QRP* and *SPR* are congruent, and their included sides *QR* and *SP* are congruent. So, by the SAS postulate, $\triangle QRT \cong \triangle SPT$. Corresponding sides of congruent triangles are congruent, so $QT = ST$ and $RT = PT$. This shows that the diagonals of a parallelogram bisect each other.

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate an understanding of how to prove that the diagonals of a parallelogram bisect each other, but may have made minor errors in reasoning or explaining answers.

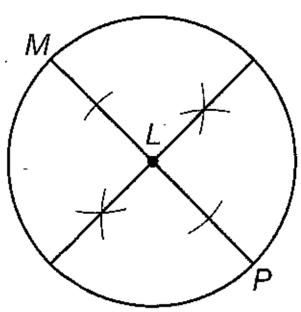
2 Student may show a correct response to two of the three parts, but may provide an incorrect or incomplete response or no response to the third part.

1 Student may show a correct response to only one of the three parts or may show a partial understanding of how to complete the proof, with errors in reasoning or insufficient explanation.

0 Student has shown little or no understanding of how to prove that the diagonals of a parallelogram bisect one another.

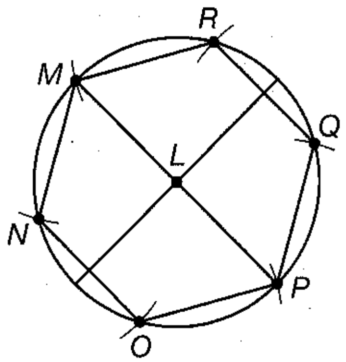
25. Answers will vary. Possible answer:

A.



1. Make an arc centered at *L* that intersects $\overline{MP}$ on either side of *L*.
2. Make two arcs centered at the point of intersection of $\overline{LM}$ and the arc constructed in Step 1.
3. Without changing the compass width, make two arcs on either side of $\overline{MP}$ centered at the point of intersection on $\overline{LP}$ and the arc constructed in Step 1.
4. Draw a line through the points of intersection formed by the arcs in Steps 2 and 3. This is a perpendicular bisector of $\overline{MP}$.

B.



1. Open the compass width to the length of $\overline{ML}$.
2. Without changing the compass width, make an arc centered at *M* that intersects with circle *L*. Label the point *N*.
3. Without changing the compass width, make an arc centered at *N* that intersects with circle *L*. Label the point *O*.
4. Without changing the compass width, make an arc centered at *P* that intersects with circle *L*. Label the point *Q*.
5. Without changing the compass width, make an arc centered at *Q* that intersects with circle *L*. Label the point *R*.
6. Draw segments $\overline{MN}$, $\overline{NO}$, $\overline{OP}$, $\overline{PQ}$, $\overline{QR}$, and $\overline{RM}$.

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may show a correct construction of the bisector, but has inscribed the incorrect type of polygon.

2 Student may show a correct construction of one, but not both, of either the bisector or the hexagon.

1 Student may show partial understanding of construction of both the bisector and the hexagon.

0 Student has shown little or no understanding of construction of either the bisector or the hexagon.

Unit 2 Assessment • **Right Triangle Trigonometry Answer Key**

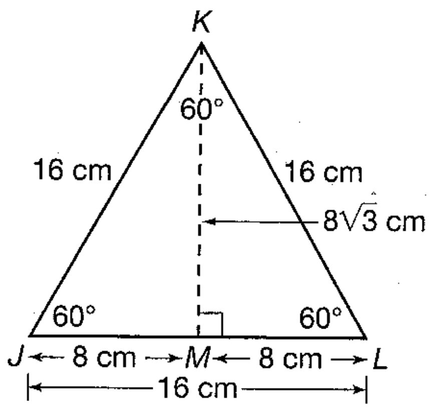
Item	Answer	Common Core Georgia Performance Standards	Level*	*Common Core Coach* Lesson(s)
1	A	MCC9-12.G.SRT.6	1	Lesson 8
2	D	MCC9-12.G.SRT.7	1	Lesson 9
3	D	MCC9-12.G.SRT.8	2	Lesson 10
4	A	MCC9-12.G.SRT.6, MP7	2	Lesson 8
5	B	MCC9-12.G.SRT.8	2	Lesson 10
6	B	MCC9-12.G.SRT.7	1	Lesson 9
7	A	MCC9-12.G.SRT.6	2	Lesson 8
8	B	MCC9-12.G.SRT.6	2	Lesson 8
9	C	MCC9-12.G.SRT.7	2	Lesson 9
10	D	MCC9-12.G.SRT.8	2	Lesson 10
11	B	MCC9-12.G.SRT.6	2	Lesson 8
12	D	MCC9-12.G.SRT.7, MP2	2	Lesson 9
13	B	MCC9-12.G.SRT.7	2	Lesson 9
14	B	MCC9-12.G.SRT.6	2	Lesson 8
15	A	MCC9-12.G.SRT.8	2	Lesson 10
16	See scoring rubric.	MCC9-12.G.SRT.6, MP7	2	Lesson 8
17	See scoring rubric.	MCC9-12.G.SRT.8	3	Lesson 10
18	See scoring rubric.	MCC9-12.G.SRT.6, MP6	3	Lesson 8
19	See scoring rubric.	MCC9-12.G.SRT.7, MP3	3	Lesson 9
20	See scoring rubric.	MCC9-12.G.SRT.8	3	Lesson 10

* Levels according to Webb's Depth of Knowledge

16. $64\sqrt{3}$ centimeters

Work may vary. Possible work: Drawing an altitude ($\overline{KM}$) divides $\triangle JKL$ into two congruent, 30°–60°–90° right triangles. Since the hypotenuse of each of those triangles is 16 cm, the smaller leg must be 16 ÷ 2, or 8, cm and the longer leg must be $8\sqrt{3}$ cm. That leg is the height. The base, $\overline{JL}$, has a length of 16 cm. So, $A = \frac{1}{2}bh = \frac{1}{2} \cdot 16 \cdot 8\sqrt{3} = 64\sqrt{3}$.

A drawing is not necessary, but students may use a drawing such as this to show work:



Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student may show a partial understanding of how to use trigonometric ratios to find the area but may have made computational or other errors, or student may give a correct answer with insufficient or no work shown.

0 Student has shown little or no understanding of how to use trigonometry to determine the area of an equilateral triangle.

17. approximately 59 feet

The distance from Shaya's eyes to the kite at a 42° angle of elevation and h, the distance from the horizontal line 5 feet above the ground to the kite, form a right triangle.

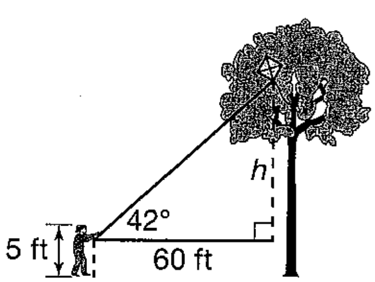
$\tan 42° = \frac{h}{60}$

$60(\tan 42°) = h$

$54 \approx h$

Shaya's eye level is 5 feet above the ground, so the actual height of the kite above the ground is approximately 54 ft + 5 ft, or 59 ft.

A drawing is not necessary, but students may use a drawing such as this to show work:



Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student may show a partial understanding of how to use the tangent ratio to determine the height of the kite, but may have made some computational errors or errors in reasoning (e.g., giving 54 feet as the answer instead of 59 feet).

0 Student has shown little or no understanding of how to use the tangent ratio and an angle of elevation to find an unknown height.

18. A. $x \approx 35$ in.

$$\tan 71° = \frac{x}{12}$$
$$(\tan 71°)(12) = x$$
$$34.9 = x$$

B. $y \approx 37$ in.

$$\cos 71° = \frac{12}{y}$$
$$(\cos 71°)(y) = 12$$
$$y = \frac{12}{(\cos 71°)} = 36.9$$

C. The values found above do satisfy the Pythagorean theorem formula. This indicates that the side lengths found for *x* and *y* form a right triangle with a 12-inch side. So, it shows that the values found for Parts A and B are reasonable.

$$a^2 + b^2 = c^2$$
$$x^2 + (12)^2 \stackrel{?}{=} y^2$$
$$35^2 + 12^2 \stackrel{?}{=} 37^2$$
$$1{,}225 + 144 \stackrel{?}{=} 1{,}369$$
$$1{,}369 = 1{,}369 \checkmark$$

Use the 4-point rubric below to assess student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate an understanding of how to use trigonometric ratios to find unknown side lengths and how to apply the Pythagorean theorem, but may show incomplete work or explanation or evidence of minor errors.

2 Student may have answered two parts correctly but failed to adequately answer a third part, or student's work may demonstrate a partial understanding of how to use trigonometric ratios and apply the Pythagorean theorem but with work that includes several computational or other errors.

1 Student may give one or more correct answers with little or no work shown or may give a correct and complete response to only one part.

0 Student has shown little or no understanding of how to use trigonometric ratios to find unknown lengths and how to apply the Pythagorean theorem.

19. A. $a^2 + b^2 = c^2$

$$\frac{a^2}{c^2} + \frac{b^2}{c^2} = \frac{c^2}{c^2}$$

B. $\sin x = \frac{a}{c}$; $\cos x = \frac{b}{c}$

$$\sin^2 x = \left(\frac{a}{c}\right)^2 = \frac{a^2}{c^2}$$
$$\cos^2 x = \left(\frac{b}{c}\right)^2 = \frac{b^2}{c^2}$$

C. I know from Part A that

$$\frac{a^2}{c^2} + \frac{b^2}{c^2} = \frac{c^2}{c^2}$$

I simplified that as

$$\frac{a^2}{c^2} + \frac{b^2}{c^2} = 1$$

I know from Part B that $\frac{a^2}{c^2} = \sin^2 x$ and $\frac{b^2}{c^2} = \cos^2 x$. So, I substituted those values into the equation from Part A:

$$\frac{a^2}{c^2} + \frac{b^2}{c^2} = 1$$
$$\sin^2 x + \cos^2 x = 1$$

This proves the Pythagorean identity.

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response.

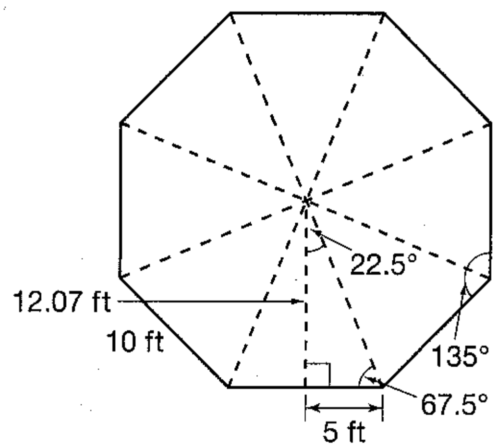
3 Student may demonstrate an understanding of how to prove the Pythagorean identity using the given steps, but may have made minor errors in computation or in explaining answers.

2 Student may show a correct response to two of the three parts, but may provide an incorrect or incomplete response or no response to the third part.

1 Student may show a correct response to only one of the three parts or may show correct responses to each part with little or no work or explanation.

0 Student has shown little or no understanding of how to prove the Pythagorean identity and little or no knowledge of the Pythagorean theorem and sine and cosine ratios.

20. A. 67.5°, 22.5°



B. $a \approx 12.07$ feet

The length of each side of the octagon is 10 feet, so the base of the right triangle is 5 feet. So:

$\tan 67.5° = \frac{a}{5}$

$(\tan 67.5°)(5) = a$

$12.07 \approx a$

C. $A \approx 482.8$ square feet

Each of the 8 triangles into which the octagon was originally divided has a base of 10 feet and a height equal to the apothem, approximately 12.07 feet. So:

A of octagon $= 8 \times \left(\frac{1}{2}bh\right) \approx 8 \times \left(\frac{1}{2} \times 10 \times 12.07\right) \approx 482.8$

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate an understanding of how to use triangles to calculate the apothem and to determine the area of the triangle, but may have made minor computational or other errors.

2 Student may show a correct response to two of the three parts, but may provide an incorrect or incomplete response or no response to the third part, or student may show partial understanding of how to use triangles to calculate the area of a regular octagon but may have work that contains significant errors.

1 Student may show a correct response to only one of the three parts or may show correct responses to two or more parts with little or no work, drawings, or explanation.

0 Student has shown little or no understanding of how to divide one of the triangles into two congruent, right triangles or how to use trigonometry to calculate the area of the octagon.

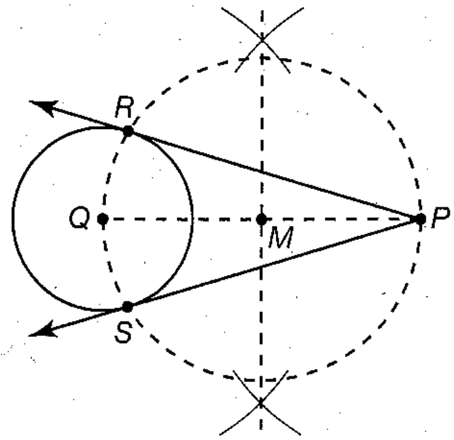
Unit 3 Assessment • **Circles and Volume Answer Key**

Item	Answer	Common Core Georgia Performance Standards	Level*	*Common Core Coach* Lesson(s)
1	C	MCC9-12.G.C.2	1	Lesson 11
2	C	MCC9-12.G.GMD.1	1	Lesson 15
3	B	MCC9-12.G.C.5	1	Lesson 13
4	A	MCC9-12.G.C.1, MP7	2	Lesson 11
5	B	MCC9-12.G.C.2	1	Lesson 12
6	D	MCC9-12.G.GMD.3	1	Lesson 16
7	C	MCC9-12.G.C.2, MP6	2	Lesson 16
8	C	MCC9-12.G.C.2	2	Lesson 12
9	D	MCC9-12.G.GMD.1, MP3	2	Lesson 15
10	B	MCC9-12.G.GMD.3	2	Lesson 16
11	D	MCC9-12.G.C.4, MP7	2	Lesson 14
12	A	MCC9-12.G.C.2	2	Lesson 11
13	A	MCC9-12.G.GMD.3, MP1	3	Lesson 16
14	C	MCC9-12.G.C.5, MP4	2	Lesson 13
15	A	MCC9-12.G.GMD.3	2	Lesson 15
16	C	MCC9-12.G.GMD.2	2	Lesson 12
17	B	MCC9-12.G.GMD.1, MP3	2	Lesson 16
18	D	MCC9-12.G.C.3	2	Lesson 14
19	B	MCC9-12.G.C.5, MP1	3	Lesson 13
20	B	MCC9-12.G.C.2, MP7	2	Lesson 11
21	See scoring rubric.	MCC9-12.G.C.4, MP5	2	Lesson 14
22	See scoring rubric.	MCC9-12.G.GMD.3, MP1	3	Lesson 16
23	See scoring rubric.	MCC9-12.G.C.3, MP3	3	Lesson 14
24	See scoring rubric.	MCC9-12.G.GMD.1, MP8	3	Lesson 15
25	See scoring rubric.	MCC9-12.G.C.5, MP4	3	Lesson 13

* Levels according to Webb's Depth of Knowledge

21. Students should construct two tangent lines from point P to circle Q. Students' constructions should show $\overline{PQ}$ and arcs that indicate that students found the perpendicular bisector of $\overline{PQ}$. The point where the perpendicular bisector intersects $\overline{PQ}$ should be the center of a circle, and the points where that circle meets circle Q should be the points of tangency.

Possible drawing:



Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student correctly completes part of the construction, such as drawing perpendicular bisectors, but fails to complete the construction, or student draws a correct tangent line, but only one.

0 Student has shown little or no understanding of how to construct a tangent line from an external point.

22. 763.02 cubic meters

V of cylinder $= \pi r^2 h \approx (3.14)(3)^2(25) \approx 706.5$

V of hemisphere $= \frac{1}{2} \cdot \frac{4}{3}\pi r^3 \approx \frac{1}{2} \cdot \frac{4}{3}(3.14)(3)^3 \approx 56.52$

V of silo $\approx 706.5 + 56.52 = 763.02$

Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student may show a partial understanding of how to find the volume of a composite solid but may have made computational or strategic errors, or student may give a correct final answer but may have shown little or no work

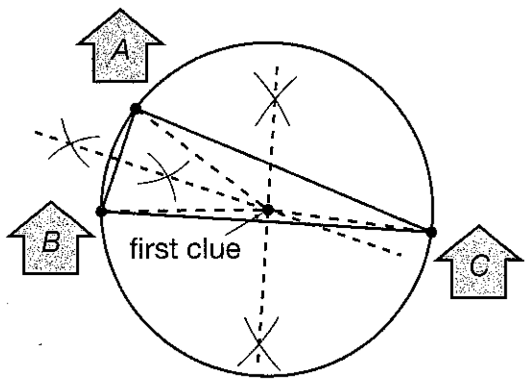
0 Student has shown little or no understanding of how to find the volume of a cylinder, a semisphere, or a composite figure.

23. A. Alicia is correct. Bella is incorrect.

The circumcenter of a triangle is the center of the circle that can be circumscribed about the triangle, so it is equidistant from all three vertices. It will show the point that is equidistant from all three cabins. The incenter is the center of the circle that can be inscribed in the triangle. It intersects each side of the triangle at exactly one point so it is equidistant from the three sides, not the three vertices.

B. Students should show that they drew the perpendicular bisectors of two or more sides of $\triangle ABC$ and should plot a point where those lines intersect, labeling it "first clue."

Possible drawing:



C. Answers may vary. See students' drawings. Sample answer: I circumscribed a circle about $\triangle ABC$. The distance from each cabin to the first clue is equal to the radius of that circle. All radii have the same length, so the diagram shows that each cabin is equidistant from the point I drew.

Use the 4-point rubric below to assess student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate understanding of incenter and circumcenter and may have correctly performed all required constructions, but may have made minor errors or only partially explained reasoning.

2 Student may have given correct responses to two of the three parts, but answered one part incorrectly or incompletely.

1 Student may give one or more correct answer(s) with little or no work shown or with work that shows major errors.

0 Student has shown little or no understanding of incenter and circumcenter and how to perform the constructions required.

24. A. The octagon can be divided into 8 triangles by drawing diagonals. Each of those triangles can be subdivided into 2 congruent, right triangles. So, the octagon can be subdivided into 2×8, or 16, right triangles and the circle inscribed in it has 16 central angles, each measuring θ.

Any regular polygon can be divided into n triangles by drawing diagonals and can then be subdivided into $2n$ right triangles. The circle inscribed in that polygon would have $2n$ central angles, each measuring θ.

A full circle measures 2π radians. So, for the octagon shown, $\theta = \frac{2\pi}{16} = \frac{\pi}{8}$.

For a polygon with n sides, $\theta = \frac{2\pi}{2n} = \frac{\pi}{n}$.

So, $n(\theta) = \pi$ and $n = \frac{\pi}{\theta}$.

B. $s = 2r(\tan\theta)$

Possible work:

$\tan\theta = \frac{\frac{1}{2}s}{r}$

$r\tan\theta = \frac{1}{2}s$

$2r\tan\theta = s$

C. $P = 2\pi r \cdot \frac{\theta}{\tan\theta}$ (or an equivalent equation)

Possible work:

$P = \frac{\pi}{\theta} \cdot 2r\tan\theta$

$P = \frac{2\pi r \times \theta}{\tan\theta}$

$P = 2\pi r \cdot \frac{\theta}{\tan\theta}$

As n increases, the perimeter of the polygon will more closely approximate the circumference of the circle. As n increases, θ decreases and $\tan\theta$ also decreases. For very large values of n, $\tan\theta \approx \theta$. So, $\frac{\theta}{\tan\theta} \approx 1$. This means that the formula for the circumference, C, of the inscribed circle is:

$C = 2\pi r \cdot \frac{\theta}{\tan\theta}$

$C = 2\pi r \cdot 1$

$C = 2\pi r$

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate an understanding of how to derive the formula for the circumference of a circle but may have made minor errors in calculation or in reasoning, or may produce explanations that are correct but incomplete.

2 Student may show a correct response to two of the three parts, but may provide an incorrect or incomplete response or no response to the third part, or student may have found correct answers for all three parts but provided incomplete or no explanation or work to support their answers.

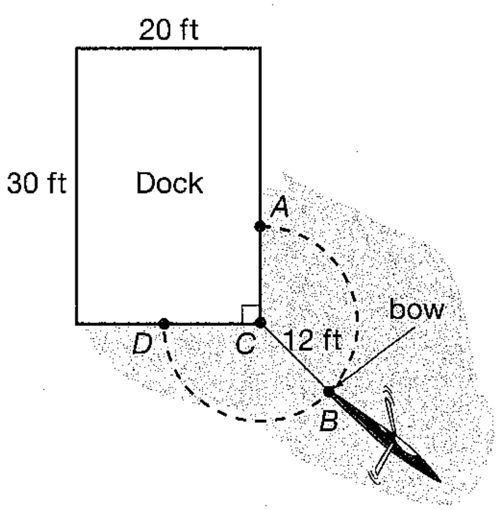
1 Student may show a correct response to only one of the three parts or may show a partial understanding of how to derive the formula, with significant errors in reasoning or insufficient explanation.

0 Student has shown little or no understanding of how to derive the formula for the circumference of a circle using a polygon circumscribed about a circle.

25. A. **Students should use a compass to draw a sector of a circle with radius equal to the 12-foot-long segment shown on the diagram and that includes an arc that measures 270°. Students should label several points, possibly including the points where the sector meets the dock and the corner of the dock, as well as the point where the bow connects to the rope.**

Possible description: The bow of the kayak can travel up to 12 feet along either edge of the dock. Since both edges are longer than 12 feet, the bow cannot go around any other corners. The area in which the bow can travel is a sector of a circle. The length of the rope, $\overline{CB}$, is its radius.

Possible drawing:



B. 339.12 square feet

Angle ACD measures 90°, so the measure of $\widehat{ABD}$ must be:

$360° - 90° = 270°$

$A = \frac{m\widehat{ABD}}{360} \cdot \pi r^2$

$A = \frac{3}{4} \cdot 12^2\pi$

$A \approx 339.12$ square feet

C. The area in which the kayak can drift is reduced by 103.62 square feet.

The measure of the angle stays the same. Only the radius changes, from 12 to 10, so:

$A_2 = \frac{m\widehat{ABD}}{360} \cdot \pi r^2$

$A_2 = \frac{3}{4} \cdot 10^2\pi$

$A \approx 235.5$ square feet

$339.12 - 235.5 = 103.62$

Use the 4-point rubric below to assess student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate understanding of how to find the area of a sector of a circle to determine the regions in which the bow can travel, but may have made errors in calculation or minor errors in drawing a representation.

2 Student may have given correct responses to two of the three parts but answered one part incorrectly or incompletely, or student may have given correct answers to all three parts but provided inadequate work or explanation.

1 Student may have drawn a correct representation but found incorrect areas for the other parts, or student may have calculated the correct area for one part only and failed to correctly respond to the other parts.

0 Student has shown little or no understanding of how to apply the area of a sector to this real-world problem.

Unit 4 Assessment • Extending the Number System Answer Key

Item	Answer	Common Core Georgia Performance Standards	Level*	*Common Core Coach* Lesson(s)
1	D	MCC9-12.A.APR.1	1	Lesson 19
2	C	MCC9-12.N.RN.3	1	Lesson 18
3	C	MCC9-12.N.CN.1, MP6	1	Lesson 20
4	D	MCC9-12.N.RN.3	2	Lesson 18
5	B	MCC9-12.N.RN.2	2	Lesson 17
6	B	MCC9-12.A.APR.1	1	Lesson 19
7	D	MCC9-12.N.RN.1, MP8	2	Lesson 18
8	B	MCC9-12.N.CN.2	2	Lesson 20
9	A	MCC9-12.N.CN.3	2	Lesson 20
10	D	MCC9-12.N.RN.3	2	Lesson 18
11	C	MCC9-12.A.APR.1	2	Lesson 19
12	A	MCC9-12.A.APR.1	2	Lesson 19
13	D	MCC9-12.N.CN.2	2	Lesson 20
14	B	MCC9-12.N.RN.1, MP8	2	Lesson 18
15	D	MCC9-12.N.CN.3, MP6	2	Lesson 20
16	See scoring rubric.	MCC9-12.N.RN.2	2	Lesson 18
17	See scoring rubric.	MCC9-12.N.CN.1, MP8	3	Lesson 20
18	See scoring rubric.	MCC9-12.A.APR.1, MP5	3	Lesson 19
19	See scoring rubric.	MCC9-12.N.CN.3, MP3	3	Lesson 20
20	See scoring rubric.	MCC9-12.N.RN.3, MP7	3	Lesson 17

* Levels according to Webb's Depth of Knowledge

16. $x = 7$

Possible work:

$2^{\frac{x}{2}} = 8\sqrt{2}$

$2^{\frac{x}{2}} = 2^3 \cdot \sqrt{2}$

$2^{\frac{x}{2}} = 2^3 \cdot 2^{\frac{1}{2}}$

$2^{\frac{x}{2}} = 2^{\frac{6}{2}+\frac{1}{2}}$

$2^{\frac{x}{2}} = 2^{\frac{7}{2}}$

$\frac{x}{2} = \frac{7}{2}$

$x = 7$

Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student may show a partial understanding of how to use exponents to solve for *x* but may have made computational or other errors, or student may give a correct answer with insufficient or no work shown.

0 Student has shown little or no understanding of how to use exponents to simplify expressions or solve equations for *x*.

17. $i^5 = i, i^{12} = 1, i^{18} = -1$

Possible work:

$i^5 = i^4 \cdot i = 1 \cdot i = i$

$i^{12} = (i^4)^3 = (1)^3 = 1$

$i^{18} = (i^2)^9 = (-1)^9 = -1$

Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student has shown a partial understanding of how to compute powers of *i* but made some errors in computation or reasoning, or student determined all three powers of *i* but showed little or no work.

0 Student has shown little or no understanding of how to compute powers of *i*.

18. A. $16x + 2$

$P = (5x + 2) + (3x - 1) + (5x + 2) + (3x - 1)$

$P = (5x + 3x + 5x + 3x) + (2 - 1 + 2 - 1)$

$P = 16x + 2$

B. $15x^2 + x - 2$

$A = (5x + 2)(3x - 1)$

$A = 15x^2 - 5x + 6x - 2$

$A = 15x^2 + x - 2$

C. **The answers for Parts A and B support Hector's statement.**

Finding the perimeter involved adding 4 polynomials (binomials) and the result was a polynomial (a binomial). Finding the area involved multiplying 2 polynomials (binomials) and the result was a polynomial (a trinomial). Being closed under addition and multiplication means that the sum of polynomials is a polynomial and the product of polynomials is a polynomial, so the perimeter and area found above support Hector's statement.

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response, as shown above.

3 Student shows understanding of how to determine the perimeter and area of a rectangle with polynomial sides and how to use them to support Hector's statement, but may have made minor errors in computation.

2 Student may demonstrate an understanding of how to find the perimeter and area of a rectangle with polynomial sides but may not adequately address how they support Hector's statement, or student may show a mostly correct response to two parts of the problem but not the third part.

1 Student may show a correct response to only one of the three parts, or student may have answered two or more parts correctly with little or no work or explanation provided.

0 Student has shown little or no understanding of how to find the perimeter and area of a rectangle with polynomial sides.

19. A. Julia multiplied the numerator and denominator by the complex number in the denominator $(2 - 4i)$, not by its complex conjugate, $2 + 4i$. The product of two complex numbers may be another complex number, but the product of two complex conjugates will always be a real number.

B. $\frac{8}{5} + \frac{7}{10}i$ or $1.6 + 0.7i$

Possible work:

$$\frac{6 - 5i}{2 - 4i} \cdot \frac{2 + 4i}{2 + 4i}$$

$$\frac{12 - 10i + 24i - 20i^2}{4 - 16i^2}$$

$$\frac{12 - 10i + 24i + 20}{4 + 16}$$

$$\frac{32 + 14i}{20}$$

$$\frac{8}{5} + \frac{7}{10}i$$

Use the 4-point rubric below to assess student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate an understanding of the error Julia made and may have correctly used the complex conjugate to simplify the expression, but made one or more computational errors.

2 Student may demonstrate an understanding and provide a clear explanation of the error Julia made but did not demonstrate knowledge of how to correctly find the quotient, or student may have found the correct quotient, showing clear work, but may not have identified or explained Julia's error.

1 Student may demonstrate some understanding of how to use complex conjugates to find the quotient but did not provide correct answers, work, or explanation indicating more than a cursory understanding.

0 Student has shown little or no understanding of how to use complex conjugates to determine the quotient.

20. A. $(2\sqrt{5} + 4)$ inches;

The sum is irrational. The sum of two rational numbers and two irrational numbers is an irrational number. If I add any irrational number to a rational number, they will not be like terms, so the sum will have to include an irrational number. The sum will always be irrational.

$P_{rect} = \sqrt{5} + 2 + \sqrt{5} + 2$

$P_{rect} = (\sqrt{5} + \sqrt{5}) + (2 + 2)$

$P_{rect} = 2\sqrt{5} + 4$

B. $2\sqrt{5}$ square inches;

The product is irrational. The product of a rational number and an irrational number is an irrational number. This will be true because if a rational number is multiplied by an irrational number, the product will include a part that is still irrational. So, the product will always be irrational.

$A = 2 \cdot \sqrt{5} = 2\sqrt{5}$

C. $P_{sq} = 3 + 3 + 3 + 3 = 12$ inches

$A_{sq} = 3 \times 3 = 9$ square inches;

The perimeter and area are both rational. The sum of rational numbers is always rational, and the product of rational numbers is always rational. Since no irrational numbers are added or multiplied, only rational numbers can result.

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response.

3 Student may respond correctly to all parts of the problem, but may have made some minor errors in calculation or in reasoning.

2 Student may show a correct response to two of the three parts but may provide an incorrect or incomplete response or no response to the third part, or student may show understanding of how to add and multiply rational and irrational numbers but may have failed to generalize the answers.

1 Student may show a correct response to only one of the three parts, or student may show correct responses to two or more parts with little or no work or explanation.

0 Student has shown little or no understanding of how to add and multiply rational and irrational numbers.

Unit 5 Assessment • **Quadratic Functions Answer Key**

Item	Answer	Common Core Georgia Performance Standards	Level*	*Common Core Coach* Lesson(s)
1	B	MCC9-12.F.IF.4	1	Lesson 26
2	B	MCC9-12.F.IF.5, MP3	1	Lesson 26
3	C	MCC9-12.A.CED.4	1	Lesson 22
4	B	MCC9-12.A.CED.1	2	Lesson 23
5	C	MCC9-12.A.REI.4b	1	Lesson 24
6	A	MCC9-12.F.BF.3	2	Lesson 27
7	D	MCC9-12.N.CN.7	1	Lesson 24
8	D	MCC9-12.A.SSE.3a	2	Lesson 22
9	D	MCC9-12.A.SSE.1a	1	Lesson 21
10	A	MCC9-12.A.REI.7	2	Lesson 25
11	D	MCC9-12.F.IF.4, MP8	2	Lesson 26
12	C	MCC9-12.F.IF.8a, MP7	2	Lesson 26
13	B	MCC9-12.A.REI.4b, MP1	2	Lesson 24
14	D	MCC9-12.A.SSE.2, MP8	2	Lesson 22
15	D	MCC9-12.F.IF.4	2	Lesson 26
16	B	MCC9-12.F.IF.7a, MP7	2	Lesson 26
17	B	MCC9-12.A.CED.2, MP2	2	Lesson 23
18	C	MCC9-12.A.REI.4a	3	Lesson 24
19	C	MCC9-12.F.BF.3	3	Lesson 27
20	A	MCC9-12.A.REI.4b, MP3	2	Lesson 24
21	A	MCC9-12.F.BF.3	2	Lesson 27
22	D	MCC9-12.F.IF.7a	2	Lesson 26
23	B	MCC9-12.F.LE.3	2	Lesson 28
24	D	MCC9-12.N.CN.7	2	Lesson 24
25	B	MCC9-12.F.BF.1b, MP3	2	Lesson 29
26	See scoring rubric.	MCC9-12.A.SSE.3b	3	Lesson 22
27	See scoring rubric.	MCC9-12.F.IF.8a, MP1	2	Lesson 26
28	See scoring rubric.	MCC9-12.A.REI.4b	3	Lesson 24
29	See scoring rubric.	MCC9-12.A.CED.2, MP6	3	Lesson 23
30	See scoring rubric.	MCC9-12.A.REI.7, MP4	3	Lesson 25

* Levels according to Webb's Depth of Knowledge

26. Answers will vary. Possible answer:

The area is given by $x(60 - 2x)$ or $-2x^2 + 60x$. The maximum is reached at the vertex, which is found by completing the square: $-2(x - 15)^2 + 450$. When one side length is 15 feet, the area is 450 square feet. The other side length is $60 - 2(15) = 30$ feet.

Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student has shown an understanding of completing the square but not of interpreting a quadratic in this form.

0 Student has shown little or no understanding of completing the square or finding the vertex of a quadratic in this form.

27. Answers will vary. Possible answer:

To complete the square, add the square of half of the x-coefficient to both sides of the equation. Then factor and simplify.

$y = x^2 - 8x - 5$

$y + 16 = x^2 - 8x + 16 - 5$

$y + 16 = (x - 4)^2 - 5$

$y = (x - 4)^2 - 21$

So the vertex is $(4, -21)$.

Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student has shown an understanding of completing the square but may have included minor computational errors.

0 Student has shown little or no understanding of completing the square.

28. Answers will vary. Possible answer:

A. $g(x) = 2x^2 + 15x - 8$

$g(x) = (2x - 1)(x + 8)$

The zeros of $g(x)$ are $x = \frac{1}{2}$ and -8.

B. **A zero of a function is an input value for which the output value is zero. By factoring a quadratic into a product of two binomial terms, the multiplicative property of zero can be applied: If either factor is equal to zero, then the product will equal zero. So each factor can be written as an equation equal to zero and solved to find a zero of the quadratic.**

C. **No, a pair of functions such as $f(x) = (x - 2)(x + 3)$ and $h(x) = 5(x - 2)(x + 3)$ have the same zeros, $x = 2$ and -3, but are distinct.**

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response, as shown above.

3 Student has given a correct response for Part A and either Part B or Part C.

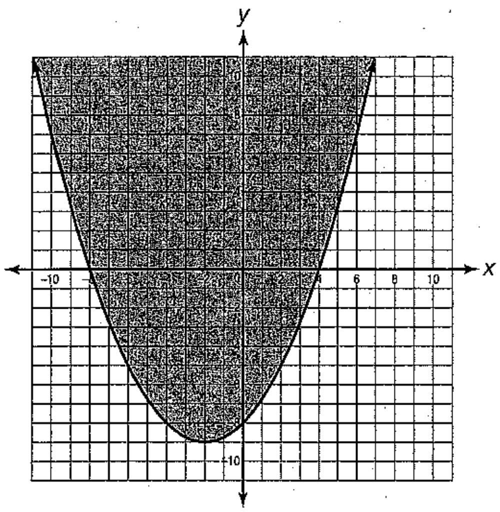
2 Student has given a correct response for Part A only or both Parts B and C.

1 Student may show partial understanding by finding incorrect zeros due to improper factoring and does not demonstrate an understanding of applying the multiplicative property of zero or determining if zeros indicate identical functions.

0 Student has shown little or no understanding of factoring a quadratic to find the zeros.

29. Answers will vary. Possible answer:

A.



B. Test points on either side of the inequality: (0, 0) and (0, −10).

For (0, 0), $b(0) \ge \frac{1}{4}(0)^2 + (0) - 8$, or $0 > -8$. This is a true statement.

For (0, −10), $b(0) \ge \frac{1}{4}(0)^2 + (0) - 8$, or $-10 > -8$. This is not a true statement.

So the graph should be shaded above the curve.

C. Because the inequality is "greater than or equal to," it includes solutions to the function $b(x) = \frac{1}{4}x^2 + x - 8$. So the boundary is included in the solution set.

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response, as shown above.

3 Student shows the correct boundary but has shaded the wrong side. However, calculations in Part B should be correct, though incorrectly interpreted.

2 Student shows the correct shading but an incorrect boundary based on an incorrect Part C.

1 Student shows the incorrect curve, but the graph corresponds to answer in Part B.

0 Student has shown little or no understanding of graphing a quadratic inequality.

30. Answers will vary. Possible answer:

A. The domain makes sense for when the rocket leaves the ground and when it returns to the ground. That is, when $r(t) = 0$.

$-16t^2 + 195t = 0$

$-t(16t + 195) = 0$

$t = 0$ or $\frac{195}{16} = 12.1875$

So the domain is [0, 12.1875].

B. To find when $b(t) = r(t)$, substitute $3t + 512$ for $r(t)$.

$3t + 512 = -16t^2 + 195t$

$0 = -16t^2 + 192t - 512$

$0 = -16(t^2 + 12t - 32)$

$0 = -16(t - 8)(t - 4)$

C. By the multiplicative property of zero, the heights are the same when $t = 4$ seconds and when $t = 8$ seconds. $r(4) = b(4) = 524$ feet and $r(8) = b(8) = 536$ feet.

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response.

3 Student may correctly interpret the domain of a function for a real-world situation and the meaning of the solution but has made an algebraic error in solving the linear-quadratic system.

2 Student may show an algebraic understanding of solving a linear-quadratic system but does not interpret the solution or restrictions on the domain.

1 Student may show partial understanding of the domain of a function for a real-world situation, solving a linear-quadratic system, or interpreting the meaning of the solution, but has not completed any one part correctly.

0 Student has shown little or no understanding of the domain of a function for a real-world situation, solving a linear-quadratic system, or interpreting the meaning of the solution.

Unit 6 Assessment • **Modeling Geometry Answer Key**

Item	Answer	Common Core Georgia Performance Standards	Level*	*Common Core Coach* Lesson(s)
1	A	MCC9-12.G.GPE.1	1	Lesson 30
2	D	MCC9-12.G.GPE.2, MP6	1	Lesson 31
3	C	MCC9-12.G.GPE.4, MP1	2	Lesson 33
4	A	MCC9-12.A.REI.7, MP3	1	Lesson 33
5	B	MCC9-12.G.GPE.2	2	Lesson 31
6	A	MCC9-12.G.GPE.1	1	Lesson 30
7	B	MCC9-12.G.GPE.4	2	Lesson 33
8	B	MCC9-12.G.GPE.2	2	Lesson 31
9	C	MCC9-12.G.GPE.1	2	Lesson 30
10	B	MCC9-12.A.REI.7, MP3	2	Lesson 33
11	D	MCC9-12.G.GPE.4	2	Lesson 33
12	B	MCC9-12.G.GPE.1, MP1	2	Lesson 30
13	C	MCC9-12.A.REI.7, MP1	2	Lesson 33
14	D	MCC9-12.G.GPE.4, MP6	2	Lesson 31
15	B	MCC9-12.G.GPE.1	2	Lesson 30
16	See scoring rubric.	MCC9-12.G.GPE.2, MP4	3	Lesson 31
17	See scoring rubric.	MCC9-12.G.GPE.1, MP8	2	Lesson 30
18	See scoring rubric.	MCC9-12.G.GPE.4, MP4	3	Lesson 32
19	See scoring rubric.	MCC9-12.A.REI.7, MP3	3	Lesson 33
20	See scoring rubric.	MCC9-12.A.REI.7, MP3	3	Lesson 33

* Levels according to Webb's Depth of Knowledge

16. The lightbulb is 1 inch from the vertex, because $p = 1$.
    The equation is: $y - k = \frac{1}{4c}(x - h)^2$. Since the vertex is at (0, 0), the equation for this parabola is $y = \frac{1}{4p}x^2$.
    Substituting the point (4, 4) into the equation, I can solve for p:

    $4 = \frac{1}{4p}(4)^2$

    $4 = \frac{1}{4p} \cdot 16$

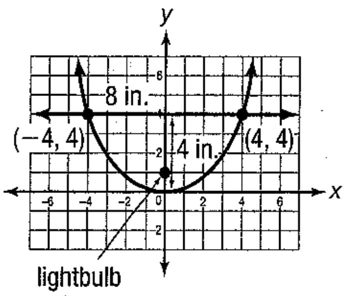
    $\frac{4}{16} = \frac{1}{4p}$

    $16p = 16$

    $p = 1$

So, the focus is at (0, 1). Students should plot and label a point there as shown.

Possible labeled drawing:



Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student may show a partial understanding of how to determine the location of the focus but may have made minor errors or failed to complete every task in the problem.

0 Student has shown little or no understanding of how to determine the location of the focus of a parabola.

17. **standard form: $(x - 2)^2 + (y + 3)^2 = 4$**

center: (2, −3)

radius: 2

Possible work:

$x^2 + y^2 - 4x + 6y + 9 = 0$

$(x^2 - 4x) + (y^2 + 6y) = -9$

$(x - 2)^2 + (y^2 + 6y) = -9 + 4$

$(x - 2)^2 + (y + 3)^2 = -5 + 9$

$(x - 2)^2 + (y + 3)^2 = 4$

Use the 2-point rubric below to grade student work.

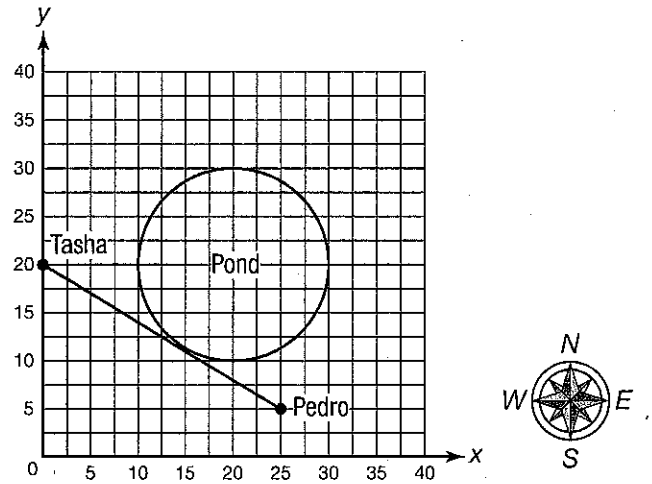
2 Student has shown a complete and correct response, as shown above.

1 Student may show a partial understanding of how to complete the square to rewrite the equation in standard form but may have made computational errors, or may have found the correct equation but incorrectly identified the center and/or radius.

0 Student has shown little or no understanding of how to convert an equation from general form to standard form.

18. **A. Students should draw a circle with center (20, 20) and radius 10 labeled as the pond. They should draw a point at (0, 20) labeled either Tasha or entrance. They should also draw a segment from (0, 20) to (25, 5) labeling the endpoint Pedro.**

Possible drawing:



B. **It is possible for Tasha to walk a straight-line path to Pedro. The entrance is at (0, 20). If Pablo is 15 feet south and 25 feet west, he is at (25, 5). The segment showing a straight-line path from Tasha to Pablo does not intersect with the circular pond, so this path is possible.**

Use the 4-point rubric below to assess student work..

4 Student has shown a complete and correct response, as shown above.

3 Student may have created a correct representation and given the correct answer, but may have failed to adequately explain the answers.

2 Student may have created a partially correct representation but made minor errors. However, student accurately interpreted the drawing created (even if the resulting answer is incorrect.)

1 Student may have created a partially correct representation without interpretation or explanation, or student may have given the correct answer but failed to represent the problem on the grid.

0 Student has shown little or no understanding of how to represent nonlinear systems and use them to solve a real-world problem.

19. A. **The slope of $\overline{MN}$ is -2 and the slope of $\overline{NP}$ is $\frac{1}{2}$. Those lines have opposite reciprocal slopes, so they must be perpendicular to one another at point N. This means that $m\angle MNP = 90°$.**

Possible work:

slope of $\overline{MN} = \frac{3-(-1)}{-2-0} = \frac{4}{-2} = -2$

slope of $\overline{NP} = \frac{-1-3}{0-8} = \frac{-4}{-8} = \frac{1}{2}$

B. **$\overline{MP}$ is a diameter of circle O because it has endpoints on the circle and it passes through the center, point O. That is the definition of a diameter.**

C. **The endpoints of arc MQP are the endpoints of $\overline{MP}$, which is a diameter. So, arc MQP is a semicircle.**

This indicates that if an inscribed angle measures 90°, it intercepts a semicircle.

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate an understanding of how to find the slopes and how to justify that a figure is a diameter or a semicircle, but may have made some minor errors in computation or reasoning.

2 Student may show a correct response to two of the three parts, but may provide an incorrect or incomplete response or no response to the third part, or student may demonstrate an understanding of how to prove that a 90° inscribed angle intercepts a semicircle but made significant errors in computation.

1 Student may show a correct response to only one of the three parts or may show correct responses to each part with little or no work or explanation.

0 Student has shown little or no understanding of how to prove that a 90° inscribed angle intercepts a semicircle.

20. A. $\overline{KL}$: $y = -x + 6$
$\overline{MN}$: $y = 2x$

B. P: (2, 4)

Students must use algebra to prove that point P is at (2, 4). Eyeballing the graph alone is not a sufficient answer for Part B.

Possible work: I substituted the value of y in one equation for y in the other and solved for x.

$-x + 6 = 2x$

$6 = 3x$

$2 = x$

So, $y = 2x = 2(2) = 4$

So, point P is at (2, 4).

C. **Students should use the distance formula to find the lengths of the segments and multiply to show that $(KP)(LP) = (MP)(NP)$.**

This indicates that when two chords intersect, the product of the segments of one chord is equal to the product of the segments of the other chord.

$KP = \sqrt{(0-2)^2 + (6-4)^2} = \sqrt{8}$

$LP = \sqrt{(7-2)^2 + (-1-4)^2} = \sqrt{50}$

$MP = \sqrt{(0-2)^2 + (0-4)^2} = \sqrt{20}$

$NP = \sqrt{(4-2)^2 + (8-4)^2} = \sqrt{20}$

$(KP)(LP) \stackrel{?}{=} (MP)(NP)$

$(\sqrt{8})(\sqrt{50}) \stackrel{?}{=} (\sqrt{20})(\sqrt{20})$

$\sqrt{400} = \sqrt{400}$ ✓

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate an understanding of how to write equations, algebraically find the point of intersection, and find distances and multiply to prove the intersecting chords theorem, but may have made some minor errors in computation or reasoning.

2 Student may show a correct response to two of the three parts but may provide an incorrect or incomplete response or no response to the third part, or student may demonstrate an understanding of how to prove the intersecting chords theorem but may have made significant errors in computation.

1 Student may show a correct response to only one of the three parts or may show correct responses to each part with little or no work or explanation.

0 Student has shown little or no understanding of how to prove the intersecting chords theorem.

Unit 7 Assessment • **Applications of Probability Answer Key**

Item	Answer	Common Core Georgia Performance Standards	Level*	*Common Core Coach* Lesson(s)
1	B	MCC9-12.S.CP.1	1	Lesson 34
2	A	MCC9-12.S.CP.2	1	Lesson 36
3	B	MCC9-12.S.CP.4	1	Lesson 35
4	C	MCC9-12.S.CP.4	2	Lesson 37
5	B	MCC9-12.S.CP.7	1	Lesson 35
6	D	MCC9-12.S.CP.1, MP2	2	Lesson 34
7	B	MCC9-12.S.CP.2	2	Lesson 36
8	C	MCC9-12.S.CP.4, MP4	2	Lesson 35
9	A	MCC9-12.S.CP.1, MP4	2	Lesson 34
10	B	MCC9-12.S.CP.3	2	Lesson 37
11	D	MCC9-12.S.CP.1, MP4	2	Lesson 34
12	A	MCC9-12.S.CP.4	2	Lesson 37
13	C	MCC9-12.S.CP.7	2	Lesson 36
14	B	MCC9-12.S.CP.6	2	Lesson 37
15	B	MCC9-12.S.CP.4	2	Lesson 37
16	See scoring rubric.	MCC9-12.S.CP.6, MP4	2	Lesson 37
17	See scoring rubric.	MCC9-12.S.CP.7, MP1	3	Lesson 36
18	See scoring rubric.	MCC9-12.S.CP.1, MP4	2	Lesson 34
19	See scoring rubric.	MCC9-12.S.CP.4, MP4	3	Lesson 35
20	See scoring rubric.	MCC9-12.S.CP.6, MP4	2	Lesson 37

* Levels according to Webb's Depth of Knowledge

16. **$\frac{1}{6}$, $0.1\overline{6}$, or $16\frac{1}{6}$%; It represents that given that a student is in the ninth grade, the probability that the student is also in the band is about 16.6%.**

$$P(B \mid A) = \frac{P(A \cap B)}{P(A)}$$
$$= \frac{\frac{12}{96}}{\frac{12+60}{96}}$$
$$= \frac{12}{12+60}$$
$$= \frac{1}{6}$$

Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student may show a partial understanding of how to calculate conditional probability, but may have made calculation errors, or the student may have calculated the correct probability but failed to adequately interpret its meaning or show work.

0 Student has shown little or no understanding of how to calculate a conditional probability.

17. $P(C \cup T) = 0.6$; It shows that if a student is selected at random from a list of eleventh- and twelfth-grade students, there is a 60% chance of selecting a student who has a car or is in twelfth grade or both.

First, I extended the table to include the marginal frequencies. Then I used the addition rule to determine this probability:

$$P(C \cup T) = P(C) + P(T) - P(C \cap T)$$
$$= \left(\frac{30}{80}\right) + \left(\frac{40}{80}\right) - \left(\frac{22}{80}\right)$$
$$= 0.375 + 0.5 - 0.275$$
$$= 0.6$$

	Have Car (C)	No Car (N)	Total
Eleventh Grade (E)	8	32	**40**
Twelfth Grade (T)	22	18	**40**
Total	**30**	**50**	**80**

Use the 2-point rubric below to grade student work.

2 Student has shown a complete and correct response, as shown above.

1 Student may show a partial understanding of how to use the addition rule to determine a probability but may have made some errors in computation, in reasoning, or in explanation, or student may have provided correct answers with little or no work or explanation.

0 Student has shown little or no understanding of how to apply the addition rule to solve a problem.

18. A. $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$

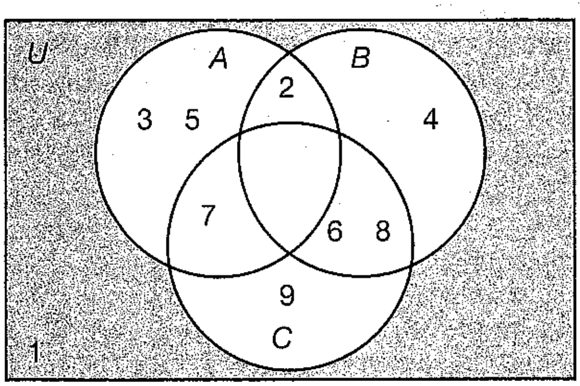
$A = \{2, 3, 5, 7\}$

$B = \{2, 4, 6, 8\}$

$C = \{6, 7, 8, 9\}$

B. Students should draw three intersecting circles and number them as shown. Then students should shade the part of the rectangle that is not inside any of the circles.

Possible drawing:



The shaded region shows the complement of the union of sets *A*, *B*, and *C*. It represents the outcome for which no player earns a point. There is only one such outcome, 1.

C. There is one empty region, where all 3 circles intersect. This shows that there is no outcome that will result in all three players earning a point.

Use the 4-point rubric below to assess student work.

4 Student has shown a complete and correct response.

3 Student may demonstrate understanding of how to represent sets and subsets in lists and in a Venn diagram and how to interpret the diagram, but may have made minor errors.

2 Student may demonstrate understanding of how to list the outcomes in sets and subsets and how to create Venn diagrams but may have made some errors when interpreting them, or student may show an understanding of how to identify sets, unions, and complements but may have been unable to represent them adequately in a Venn diagram.

1 Student may demonstrate a partial understanding of how to list the items that belong to sets, but may have failed to create an effective Venn diagram.

0 Student has shown little or no understanding of how to represent sets and subsets in lists or as a Venn diagram.

19. A.

	Pizza	**Chicken**	**Tacos**	**Total**
Boys	25	4	11	40
Girls	7	20	13	40
Total	32	24	24	80

B. **$\frac{2}{5}$, 0.4, or 40%**

The relative frequency of a student liking pizza best was $\frac{32}{80} = 0.4$. This means that if a tenth-grade student were chosen at random, the probability that the student would prefer pizza would be about 40%.

C. **$\frac{5}{8}$, 0.625 or 62.5%**

To find this relative frequency, only the row for boys is considered. $\frac{25}{40}$ boys chose pizza, so the probability that a tenth-grade boy chosen at random would prefer pizza is $\frac{25}{40}$ or 62.5%

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate an understanding of how to construct a two-way frequency table and how to interpret it, but may have made some minor errors calculating probabilities.

2 Student may show a correct frequency table and may have correctly answered either Part B or C, but may have provided an incorrect or incomplete response or no response to the other part, or student may have made errors when completing the frequency table but correctly answered Parts B and C based on the data in the table.

1 Student may show a partial understanding of how to complete a two-way table and how to use relative frequencies to find probabilities, but may have made significant errors in representation and reasoning.

0 Student has shown little or no understanding of how to represent data in a two-way table or interpret the data.

20. A. a chocolate cupcake (*C*): $\frac{1}{2}$

a yellow cupcake (*Y*): $\frac{1}{3}$

a strawberry cupcake (*S*): $\frac{1}{6}$

Possible work:

$$P(C \mid B) = \frac{P(C \cap B)}{P(B)} = \frac{\frac{1}{5}}{\frac{2}{5}} = \frac{1}{2}$$

$$P(Y \mid B) = \frac{P(Y \cap B)}{P(B)} = \frac{\frac{2}{15}}{\frac{2}{5}} = \frac{1}{3}$$

$$P(S \mid B) = \frac{P(S \cap B)}{P(B)} = \frac{\frac{1}{15}}{\frac{2}{5}} = \frac{1}{6}$$

B. The probability of selecting a cupcake with red icing and chocolate cake is the same as the probability of selecting a cupcake with red icing and strawberry cake, $\frac{1}{20}$.

$$P(C \mid R) = \frac{\frac{1}{20}}{\frac{1}{5}} = \frac{1}{4}$$

$P(S \mid R) = \frac{1}{4}$ also.

Of the cupcakes that have red icing, $\frac{1}{4}$ of them have chocolate cake and $\frac{1}{4}$ of them have strawberry cake. If it was given that Katie chose a cupcake with red icing, there would be the same chance that she chose a chocolate cupcake as a strawberry cupcake, a 25% chance.

Use the 4-point rubric below to grade student work.

4 Student has shown a complete and correct response, as shown above.

3 Student may demonstrate an understanding of how to calculate and apply conditional probability, but may have made minor errors in calculation.

2 Student may show a correct and complete response to one of the two parts and a partially correct response to the other part, but may have made significant errors in computation or reasoning.

1 Student may show a correct response to only one part and an incorrect or no response to the other part, or student may have provided correct responses to both parts with no work shown.

0 Student has shown little or no understanding of how to apply conditional probability and interpret a tree diagram.

Summative Assessment Answer Key

Item	Answer	Common Core Georgia Performance Standards	Level*	*Common Core Coach* Lesson(s)
1	A	MCC9-12.G.C.1	1	Lesson 11
2	B	MCC9-12.G.SRT.2	1	Lesson 1
3	C	MCC9-12.G.CO.4, MP6	1	Lesson 18
4	A	MCC9-12.G.SRT.6	1	Lesson 8
5	C	MCC9-12.A.APR.1	1	Lesson 19
6	C	MCC9-12.G.SRT.3	2	Lesson 2
7	A	MCC9-12.A.SSE.1a	1	Lesson 21
8	C	MCC9-12.G.C.2	2	Lesson 12
9	D	MCC9-12.N.RN.1	2	Lesson 18
10	A	MCC9-12.G.GPE.1	1	Lesson 30
11	C	MCC9-12.S.CP.1	1	Lesson 34
12	D	MCC9-12.N.CN.1, MP7	2	Lesson 20
13	A	MCC9-12.G.GPE.2	1	Lesson 31
14	C	MCC9-12.G.GMD.1	1	Lesson 15
15	C	MCC9-12.S.CP.4	2	Lesson 35
16	D	MCC9-12.G.CO.6	1	Lesson 3
17	C	MCC9-12.G.CO.13, MP5	2	Lesson 7
18	A	MCC9-12.S.CP.3	2	Lesson 37
19	D	MCC9-12.A.REI.7	2	Lesson 25
20	D	MCC9-12.N.RN.2, MP6	2	Lesson 18
21	B	MCC9-12.G.C.2	2	Lesson 11
22	C	MCC9-12.G.SRT.7, MP5	2	Lesson 9
23	C	MCC9-12.S.CP.2, MP1	2	Lesson 36
24	D	MCC9-12.G.CO.12, MP5	2	Lesson 6
25	D	MCC9-12.A.SSE.2, MP8	2	Lesson 22
26	A	MCC9-12.G.C.5, MP2	2	Lesson 13
27	A	MCC9-12.F.IF.7a, MP5	2	Lesson 26
28	B	MCC9-12.G.CO.9	2	Lesson 5
29	A	MCC9-12.S.CP.5	2	Lesson 37
30	B	MCC9-12.N.CN.2	2	Lesson 20
31	A	MCC9-12.S.ID.6a, MP2	2	Lesson 29
32	B	MCC9-12.A.CED.2	2	Lesson 23
33	B	MCC9-12.A.REI.7	2	Lesson 32
34	B	MCC9-12.F.BF.3, MP7	2	Lesson 27
35	C	MCC9-12.G.C.4	2	Lesson 14
36	C	MCC9-12.A.REI.4a	3	Lesson 24
37	D	MCC9-12.F.IF.9, MP8	2	Lesson 28

Summative Assessment Answer Key *(Continued)*

Item	Answer	Common Core Georgia Performance Standards	Level*	*Common Core Coach* Lesson(s)
38	B	MCC9-12.G.CO.10	3	Lesson 5
39	D	MCC9-12.N.CN.7	2	Lesson 24
40	C	MCC9-12.S.CP.7, MP4	2	Lesson 36
41	A	MCC9-12.N.CN.3	3	Lesson 20
42	C	MCC9-12.A.SSE.3b	2	Lesson 22
43	C	MCC9-12.G.GMD.3, MP1	3	Lesson 16
44	C	MCC9-12.G.CO.8	2	Lesson 4
45	D	MCC9-12.G.SRT.8, MP1	3	Lesson 10
46	C	MCC9-12.G.CO.11	3	Lesson 5
47	A	MCC9-12.G.C.3, MP3	3	Lesson 14
48	B	MCC9-12.G.SRT.4, MP3	3	Lesson 2
49	A	MCC9-12.S.CP.6, MP4	3	Lesson 37
50	B	MCC9-12.G.GPE.4, MP3	3	Lesson 33

* Levels according to Webb's Depth of Knowledge