Table of Contents

Questions 1 – 3: Content Summary and Answer Key .......................................................... ii

Question 1: Question and Scoring Guidelines .................................................................. 1
Question 1: Sample Responses .......................................................................................... 3

Question 2: Question and Scoring Guidelines .................................................................. 9
Question 2: Sample Response .......................................................................................... 11

Question 3: Question and Scoring Guidelines .................................................................. 13
Question 3: Sample Responses .......................................................................................... 17
<table>
<thead>
<tr>
<th>Question No.</th>
<th>Item Type</th>
<th>Content Cluster</th>
<th>Content Standard</th>
<th>Answer Key</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equation Item</td>
<td>Apply geometric concepts in modeling situations.</td>
<td>Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). (G.MG.2)</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>2</td>
<td>Multiple Choice</td>
<td>Apply geometric concepts in modeling situations.</td>
<td>Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). (G.MG.1)</td>
<td>A</td>
<td>1 point</td>
</tr>
<tr>
<td>3</td>
<td>Equation Item</td>
<td>Define trigonometric ratios and solve problems involving right triangles.</td>
<td>Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. (G.SRT.8)</td>
<td>---</td>
<td>1 point</td>
</tr>
</tbody>
</table>
Geometry
Item Release

Question 1

Question and Scoring Guidelines
Question 1

In 2014, the population of Hong Kong was estimated to be approximately 7,112,688 people. The city covers an area of approximately 426.25 square miles.

What was the population density of Hong Kong in 2014, in people per square mile, rounded to the nearest person?

Points Possible: 1

Content Cluster: Apply geometric concepts in modeling situations.

Content Standard: Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). (G.MG.2)

Scoring Guidelines

Exemplar Response

• 16687

Other Correct Responses

• 16686

For this item, a full-credit response includes:

• A correct value (1 point).
Geometry
Item Release

Question 1

Sample Responses
Sample Response: 1 point

In 2014, the population of Hong Kong was estimated to be approximately 7,112,688 people. The city covers an area of approximately 426.25 square miles.

What was the population density of Hong Kong in 2014, in people per square mile, rounded to the nearest person?

16686

Notes on Scoring

This response earns full credit (1 point) because it shows a correct population density of Hong Kong, in people per square mile, rounded down to the nearest person.

A density can be viewed as a distribution of quantity (e.g., mass, energy, population, etc.) per unit of measure (volume, area, length, etc.). In this situation, a population density is a measurement of a population (number of people) per unit of area they live on (square miles). Since, in 2014, the population of Hong Kong was 7,112,688 people and the area of the city was about 426.25 square miles, the population density was 7,112,688 people ÷ 426.25 square miles = 16686.7 people per square mile, or 16686 people per square mile, if rounded down to the nearest person.
Sample Response: 1 point

In 2014, the population of Hong Kong was estimated to be approximately 7,112,688 people. The city covers an area of approximately 426.25 square miles.
What was the population density of Hong Kong in 2014, in people per square mile, rounded to the nearest person?

16687

Notes on Scoring

This response earns full credit (1 point) because it shows a correct population density of Hong Kong, in people per square mile, rounded to the nearest person.

A density can be viewed as a distribution of quantity (e.g., mass, energy, population, etc.) per unit of measure (volume, area, length, etc.). In this situation, a population density is a measurement of a population (number of people) per unit of area they live on (square miles). Since, in 2014, the population of Hong Kong was 7,112,688 people and the area of the city was about 426.25 square miles, the population density was 7,112,688 people ÷ 426.25 square miles = 16686.7 people per square mile, or 16687 people per square mile, if rounded up to the nearest person.
Sample Response: 0 points

In 2014, the population of Hong Kong was estimated to be approximately 7,112,688 people. The city covers an area of approximately 426.25 square miles. What was the population density of Hong Kong in 2014, in people per square mile, rounded to the nearest person?

0.00006

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect population density of Hong Kong. The student may have incorrectly divided the area by the population, $426.25 \div 7,112,688 \approx 0.00006$. 
In 2014, the population of Hong Kong was estimated to be approximately 7,112,688 people. The city covers an area of approximately 426.25 square miles.

What was the population density of Hong Kong in 2014, in people per square mile, rounded to the nearest person?

3031783260

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect calculation of the population density of Hong Kong. The student may have incorrectly multiplied the population by the area, $7,112,688 \times 426.25 = 3,031,783,260$. 

Sample Response: 0 points
Geometry
Item Release

Question 2

Question and Scoring Guidelines
Question 2

A company wants to determine the amount of a vitamin mix that can be enclosed in a capsule like the one shown. The capsule has a radius of 3 millimeters (mm) and a length of 15mm.

Which statement best explains how to find the amount of vitamin mix that fits in the capsule?

A. Add the volume of a sphere with a radius of 3 millimeters to the volume of a cylinder with a radius of 3 millimeters and a height of 9 millimeters.
B. Add the volume of a sphere with a radius of 3 millimeters to the volume of a cylinder with a radius of 3 millimeters and a height of 15 millimeters.
C. Add the volume of a sphere with a radius of 6 millimeters to the volume of a cylinder with a radius of 6 millimeters and a height of 9 millimeters.
D. Add the volume of a sphere with a radius of 6 millimeters to the volume of a cylinder with a radius of 6 millimeters and a height of 15 millimeters.

Points Possible: 1

Content Cluster: Apply geometric concepts in modeling situations.

Content Standard: Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). (G.MG.1)
Scoring Guidelines

Rationale for Option A: Key – The student correctly recognized that the capsule is a composite shape consisting of a cylinder and two congruent hemispheres (half spheres) that together make one whole sphere. The volume of the capsule is the sum of the volume of the whole sphere with radius 3 mm and the volume of the cylinder with radius 3 mm and the height that is 2 radii less than the length of the entire capsule, or $15 - 3 - 3 = 9$ mm.

Rationale for Option B: This is incorrect. The student may have correctly used 3 mm for the radius of the sphere but forgot to subtract the radius of each hemisphere from the height of the cylinder.

Rationale for Option C: This is incorrect. The student may have thought that since the volume of the whole sphere is twice the volume of a hemisphere, the radius of the whole sphere is twice the radius of a hemisphere, or 6 mm. The student may have then used this incorrect radius as the radius of the cylinder, but correctly calculated the height of the cylinder as 9 mm.

Rationale for Option D: This is incorrect. The student may have thought that since the volume of the whole sphere is twice the volume of a hemisphere, the radius of the whole sphere is twice the radius of a hemisphere, or 6 mm. The student may have then used this incorrect radius as the radius of the cylinder and forgotten to subtract the radius of each hemisphere from the length of the entire capsule to calculate the height of the cylinder.

Sample Response: 1 point
Geometry
Item Release

Question 3

Question and Scoring Guidelines
A sign company is building a sign with the dimensions shown.

10 ft

13 ft

What is the area, in square feet, of the sign?

Points Possible: 1

Content Cluster: Define trigonometric ratios and solve problems involving right triangles.

Content Standard: Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. (G.SRT.8)
Scoring Guidelines

Exemplar Response

• 60

Other Correct Responses

• Any equivalent value

For this item, a full-credit response includes:

• The correct area (1 point).
Geometry
Item Release

Question 3

Sample Responses
A sign company is building a sign with the dimensions shown.

10 ft

13 ft

What is the area, in square feet, of the sign?

60
Notes on Scoring

This response earns full credit (1 point) because it shows the correct area of the sign, 60 square feet.

The given sign is the shape of the triangle. The area, \( A \), of the sign can be found by using the formula \( A = \frac{1}{2} bh \), where \( b \) is the length of the base, 10 feet, and \( h \) is the unknown height (dashed line segment) of the triangle.

The height separates the original triangle into two congruent right triangles. In each right triangle, the length of the shorter leg is half of the length of the original base, \( \frac{10}{2} = 5 \) feet; the length of the hypotenuse is 13 feet; and the length of the longer leg is \( h \). The Pythagorean Theorem, which states that the sum of the squares of the length of each leg of a right triangle equals the square of the hypotenuse, can be used to calculate the length of the longer leg,

\[
5^2 + h^2 = 13^2 \\
h^2 = 13^2 - 5^2 \\
h^2 = 144 \\
h = 12
\]

The values of \( b = 10 \) and \( h = 12 \) can be substituted into the area formula to calculate the area of the sign,

\[
A = \frac{1}{2} \cdot 10 \cdot 12 = 60 \text{ square feet.}
\]
Sample Response: 0 points

A sign company is building a sign with the dimensions shown.

10 ft

13 ft

What is the area, in square feet, of the sign?

130

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect area of the sign, 130 square feet. The student may have incorrectly used the formula $A = \frac{1}{2}bh$ for the area of the triangle by confusing the height with the side length, 13 feet, and did not multiply the product of the two side lengths by $\frac{1}{2}$. 
Sample Response: 0 points

A sign company is building a sign with the dimensions shown.

10 ft

13 ft

What is the area, in square feet, of the sign?

65

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect area of the sign, 65 square feet. The student may have incorrectly used the formula $A = \frac{1}{2}bh$ for the area of the triangle by confusing the height with the side length, 13 feet.