2022 MCAS Sample Student Work and Scoring Guide

Grade 10 Mathematics
Question 34: Constructed-Response

Reporting Category: Geometry
Standards: GEO.G-GMD.A.3 - Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
MII.G-GMD.A.3 - Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
Item Description: Use volume formulas for cylinders and spheres to solve real-world problems.
Calculator: Allowed

View item in MCAS Digital Item Library

Scoring Guide

Select a score point in the table below to view the sample student response.

Score*	Description
4A	The student response demonstrates an exemplary understanding of the Geometry concepts involved in using volume formulas for cylinders and spheres to solve problems.
4B	The student calculates volumes of two figures and uses these volumes to solve a problem based on a real-world situation.
3	The student response demonstrates a good understanding of the Geometry concepts involved in using volume formulas for cylinders and spheres to solve problems. Although there is significant evidence that the student was able to recognize and apply the concepts involved, some aspect of the response is flawed. As a result, the response merits 3 points.
2	The student response demonstrates a fair understanding of the Geometry concepts involved in using volume formulas for cylinders and spheres to solve problems. While some aspects of the task are completed correctly, others are not. The mixed evidence provided by the student merits 2 points.
1	The student response demonstrates a minimal understanding of the Geometry concepts involved in using volume formulas for cylinders and spheres to solve problems.
0	The student response contains insufficient evidence of an understanding of the Geometry concepts involved in using volume formulas for cylinders and spheres to solve problems. As a result, the response does not merit any points.

*Letters are used to distinguish between sample student responses that earned the same score (e.g., 4A and 4B).

Score Point 4A

This question has four parts.

A vase in the shape of a right circular cylinder has a diameter of 22 centimeters.

Part A

What is the area, in square centimeters, of the base of the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

> The base of a right circular cylinder is a circle. The area is pi * r^2 .
> $r = \frac{d}{2} = 11$. Thus, the area, in square centimeters, of the base of the vase is 121pi or 380.13.

Part B

The vase is partially filled with water to a depth of 10 centimeters.

What is the volume, in cubic centimeters, of the water in the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

> The formula for the volume of a cylinder is pi $r^2 h$. There are 10cm of water, so we can treat h as those 10cm, as we are solving for only the volume of the water. Thus, we have 121pi * 10 = 1210pi or 3801.33 cubic centimeters of water.

Part C

A solid sphere with a diameter of 12 centimeters is placed into the vase.

What is the volume, in cubic centimeters, of the sphere? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

> The formula for the volume of a sphere is $\frac{4}{3}$ pi r^3. The radius is $\frac{12}{2} = 6$.
> Thus, the volume, in cubic centimeters, of the sphere, is $\frac{4}{3} 6^3 \pi = 288 \pi$ or 904.78.

Part D

The sphere sinks to the bottom of the vase. As a result, the water level rises, but the water does not overflow.

What is the total number of centimeters the water level in the vase rises when the sphere sinks to the bottom? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

The volume of a cylinder is pi $r^2 h$. We have a total of $3801.33 + 904.78 = 4706.11$ square centimeters of water. Thus, we can solve for h to get the height of the water. We have pi $11^2 h = 4706.11$, $h = \frac{4706.11}{121\,\pi} = 12.38$. Given that the original height of the water was 10cm, the amount the water level rose is $12.38 - 10 = 2.38\,\text{cm}$.

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Score Point 4B

This question has four parts.

A vase in the shape of a right circular cylinder has a diameter of 22 centimeters.

Part A

What is the area, in square centimeters, of the base of the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

area = πr^2

area = $\left(\frac{22}{2}\right)^2 (\pi)$

area = $11^2 (\pi)$

area = 121π cm^2

or 379.94 cm^2

Part B

The vase is partially filled with water to a depth of 10 centimeters.

What is the volume, in cubic centimeters, of the water in the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

V = $\pi r^2 h$

V = $121\pi \times h$

V = $121\pi \times 10$

V = 1210π cm^3

or 3799.4 cm^3

Part C

A solid sphere with a diameter of 12 centimeters is placed into the vase.

What is the volume, in cubic centimeters, of the sphere? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

$V = \frac{4}{3}\pi r^3$

$V = \frac{4}{3}\left(\frac{12}{2}\right)^3 (\pi)$

$V = \frac{4}{3}(216\pi)$

$V = 288\pi \ \text{cm}^3$

or 904.32 cm^3

Part D

The sphere sinks to the bottom of the vase. As a result, the water level rises, but the water does not overflow.

What is the total number of centimeters the water level in the vase rises when the sphere sinks to the bottom? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

water without sphere = 10 cm^3

$1210\pi \ \text{cm}^3$

sphere = $288\pi \ \text{cm}^3$

1210 + 288 = 1498

$1498\pi \ \text{cm}^3 = \pi r^2 h$

$1498\pi \ \text{cm}^3 = 121\pi h$

12.38 = h

$12.38 - 10 = 2.38 \ \text{cm}$

2.38 cm

Score Point 3

This question has four parts.

A vase in the shape of a right circular cylinder has a diameter of 22 centimeters.

Part A

What is the area, in square centimeters, of the base of the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

> 380.13 square centimeters. $\pi r^2 = 121\pi = 380.13$.

Part B

The vase is partially filled with water to a depth of 10 centimeters.

What is the volume, in cubic centimeters, of the water in the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

> 3801.33 cubic centimeters. $380.13 \times 10 = 3801.33$

Part C

A solid sphere with a diameter of 12 centimeters is placed into the vase.

What is the volume, in cubic centimeters, of the sphere? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

> 904.78 cubic centimeters. $\frac{4}{3}\pi r^3 = 288\pi = 904.78$

Part D

The sphere sinks to the bottom of the vase. As a result, the water level rises, but the water does not overflow.

What is the total number of centimeters the water level in the vase rises when the sphere sinks to the bottom? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

> The water level rises about 8 cm. The new volume would be 4706.11.
> $\frac{3801.33}{4706.11} = .8.$ $10 \times .8 = 8$

Score Point 2

This question has four parts.

A vase in the shape of a right circular cylinder has a diameter of 22 centimeters.

Part A

What is the area, in square centimeters, of the base of the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

$A = \pi r^2$

$A = 11^2 \pi$

$A = 121\pi$

$A = 380 \text{ cm}^2$

Part B

The vase is partially filled with water to a depth of 10 centimeters.

What is the volume, in cubic centimeters, of the water in the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

$V = \pi \, (121) \, (10)$

$V = 1210\pi$

$V = 3801 \text{ cm}^3$

Part C

A solid sphere with a diameter of 12 centimeters is placed into the vase.

What is the volume, in cubic centimeters, of the sphere? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

$V = \frac{4}{3}\pi(6)^2$

$V = 48\pi$

$V = 151 \text{ cm}^3$

Part D

The sphere sinks to the bottom of the vase. As a result, the water level rises, but the water does not overflow.

What is the total number of centimeters the water level in the vase rises when the sphere sinks to the bottom? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

The water will rise by 151 cm^3 because it will rise by the volume of the sphere inside the cylinder.

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Score Point 1

This question has four parts.

A vase in the shape of a right circular cylinder has a diameter of 22 centimeters.

Part A

What is the area, in square centimeters, of the base of the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

$A = \pi r^2$

$A = \pi 11^2$

$A = 121\pi$

$A = 380.1 \text{ cm}^2$

Part B

The vase is partially filled with water to a depth of 10 centimeters.

What is the volume, in cubic centimeters, of the water in the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

$V = \pi r^2 h$

$V = \pi 11^2 (10)$

$V = \pi 121 (10)$

$V = 131\pi$

$V = 411.5 \text{ cm}^3$

Part C

A solid sphere with a diameter of 12 centimeters is placed into the vase.

What is the volume, in cubic centimeters, of the sphere? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

$$V = \frac{4}{3}\pi r^3$$

$$V = \frac{4}{3}\pi 12^3$$

$$V = \frac{4}{3}\pi 1728$$

$$V = 2304\pi$$

$$V = 7238.2 \, \text{cm}^3$$

Part D

The sphere sinks to the bottom of the vase. As a result, the water level rises, but the water does not overflow.

What is the total number of centimeters the water level in the vase rises when the sphere sinks to the bottom? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

$$7238.2 - 411.5 = 6826.7 \, \text{cm}$$

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Score Point 0

This question has four parts.

A vase in the shape of a right circular cylinder has a diameter of 22 centimeters.

Part A

What is the area, in square centimeters, of the base of the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

> The area of the vase would be 12 because the diameter is 22.

Part B

The vase is partially filled with water to a depth of 10 centimeters.

What is the volume, in cubic centimeters, of the water in the vase? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

> The volume in cubic cenitmeters would be 32 because i added 10 to the 22 because of the water.

Part C

A solid sphere with a diameter of 12 centimeters is placed into the vase.

What is the volume, in cubic centimeters, of the sphere? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

> It would be 44 if you take the 32 and add the 12 centimeters because of the sphere.

Part D

The sphere sinks to the bottom of the vase. As a result, the water level rises, but the water does not overflow.

What is the total number of centimeters the water level in the vase rises when the sphere sinks to the bottom? Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

> The water would raise another 5 centimeters because the water was 10 and the sphere was 12 centimeters.

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