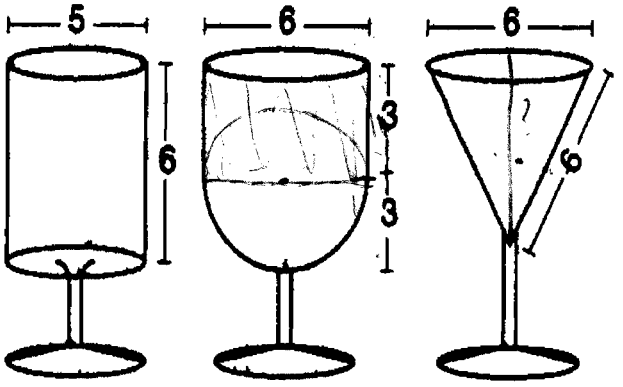
Glasses

This diagram shows three glasses (not drawn to scale).

The measurements are all in centimeters.

The volume of a cylinder $= \pi r^2 h$
The volume of a sphere $= \frac{4\pi r^3}{3}$
The volume of a cone $= \frac{\pi r^2 h}{3}$



The bowl of glass 1 is cylindrical. The diameter is 5 cm and the height is 6 cm.

The bowl of glass 2 is a cylinder with a hemispherical bottom. The diameter is 6 cm and the height of the cylinder is 3 cm.

The bowl of glass 3 is an inverted cone. The diameter is 6 cm and the slant height is 6 cm.

1. Find the vertical height of the bowl of glass 3. Show your work.

Pythagoream theorem: Radius = 3

$6^2 = 3^2 + b^2$ $\quad b = \sqrt{27} = b = 3\sqrt{3}$

$b^2 = 6^2 - 3^2$

$b^2 = 36 - 9$

$\sqrt{b^2} = \sqrt{27}$

$3\sqrt{3}$ or 5.2 cm.

2. Calculate the volume of the bowl of each of these glasses. Show your work.

a. Glass 1

radius = d ÷ 2 $\quad 5 \div 2 = 2.5$ = radius $\quad 6$ = height

$2.5^2(6)\pi = 6.25 \cdot 6\pi = 37.5\pi$ $\quad$ 117.75 cm³

$\frac{117.8 \text{ or } 37.5\pi}{}$ cm³

b. Glass 2

sphere $= \frac{4\pi r^3}{3} = \frac{4\pi 3^3}{3} = \frac{4\pi 27}{3} = \frac{108\pi}{3} = 36\pi \div 2 = (18\pi)$ because need to make it a hemisphere $\quad 45\pi$ or 141.3 cm³

cylinder $= \pi r^2 h = \pi 3^2 \cdot 3 = \pi 9 \cdot 3 = (27\pi)$

cylinder + hemisphere = glass 2

$27\pi + 18\pi = 45\pi$ or 141.3 cm³

c. Glass 3

From problem 1 you get the height of it which is $3\sqrt{3}$. radius = 3 $\quad 15.6\pi$ or 48.9 cm³

cone $= \frac{\pi 3^2 \cdot 3\sqrt{3}}{3} = \pi 3^2 \sqrt{3} = \pi 9\sqrt{3} = 15.588\pi$

$\approx 15.6\pi$

or 48.9 cm³

T1

3. Find the height of liquid in Glass 2 when it is half full. Show your calculations.

3.5 cm

height of hemisphere = 3 3cm already filled

45π = height of glass 2

45π ÷ 2 = mdpt = 22.5π - Liquid

22.5π - 18π = 4.5π ; Bottom is full so only the sphere is remained

4.5π = (3^2 h π) = volume of cylinder

4.5π = 9hπ

$\frac{4.5}{9} = \frac{9h}{9}$

h = .5

.5 from cylinder plus hemisphere 3cm equals

3.5 cm

~~5+3 = 3.5~~

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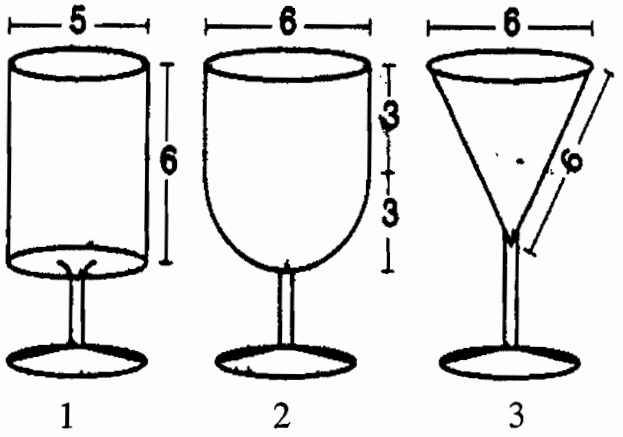

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1. Find the vertical height of the bowl of glass 3. Show your work.

$\sqrt{6^2}$ $3^2 + x^2 = 6^2$ $3\sqrt{3}$
$9 + x^2 = 36$ $\sqrt{27}$
$x^2 = 27$

$3\sqrt{3}$ cm.

2. Calculate the volume of the bowl of each of these glasses. Show your work.

a. Glass 1 $\pi\ 2.5^2\ 6$
$\pi\ 6.25 \times 6$

37.5π cm^3

b. Glass 2 $\frac{4\pi 3^3}{3}$ $\frac{36\pi}{2}$ 18π 27π
$\pi 3^2 3$

45π cm^3

c. Glass 3

$\frac{\pi 9 \cdot 3\sqrt{3}}{3}$ $\pi 9\sqrt{3}$

$\pi\ 9\sqrt{3}$ cm^3

T2

3. Find the height of liquid in Glass 2 when it is half full. Show your calculations.

$3\frac{1}{2}$ cm

22.5π

4.5π of the cylinder

$\frac{4.5}{27}$ $\frac{1}{6}$ $\times 3 = \frac{1}{2}$ cm

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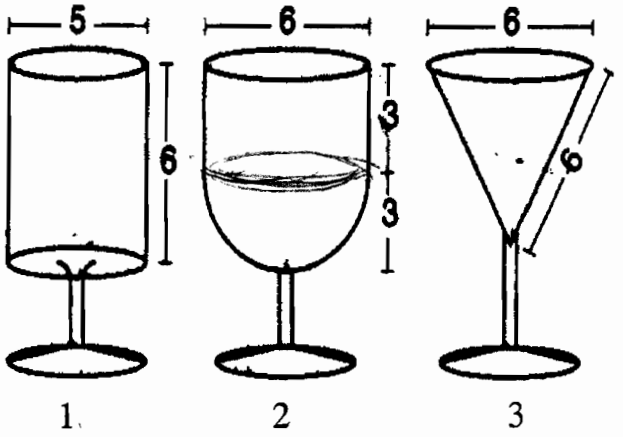

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1. Find the vertical height of the bowl of glass 3. Show your work.

$\frac{6}{a} = 3$ $\quad 3^2 + x^2 = 36$

$9 + x^2 = 36$

$x^2 = 27$

$x = 5.196$

5.196 cm.

2. Calculate the volume of the bowl of each of these glasses. Show your work.

a. Glass 1

$(2.5)^2(6)(\pi) = 117.81$

117.81 cm^3

b. Glass 2

$(3)^2(3)(\pi) + \frac{4\pi(3)^3}{3 \cdot 2} = 84.823 + 56.55 = 141.372$

141.37 cm^3

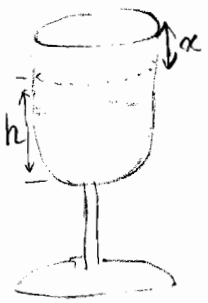
c. Glass 3

$\frac{\pi(3)^2(5.196)}{3} = 3\pi(5.196) = 48.97114628$

48.97 cm^3

3. Find the height of liquid in Glass 2 when it is half full. Show your calculations.

3.5 cm



$\frac{141.37}{2} = 70.685$

$9\pi(x) = 70.685$

$28.274x = 70.685$

$x = 2.5$

$h = 6 - 2.5 = 3.5$

T4

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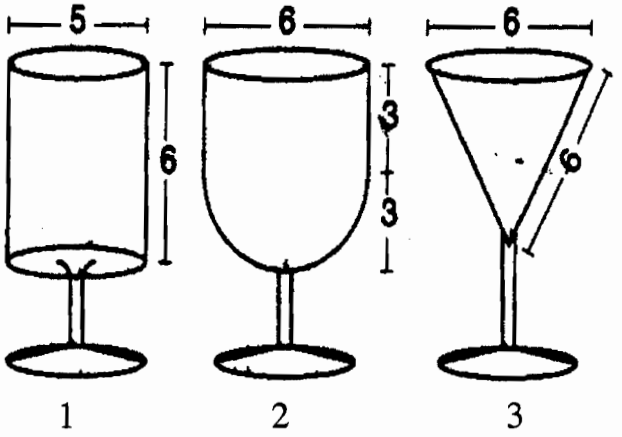

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$3^2 + b^2 = 6^2$

$9 + b^2 = 36$

$b^2 = 27$

$b = 3\sqrt{3}$

$3\sqrt{3}$ cm.

2. Calculate the volume of the bowl of each of these glasses. Show your work.

a. Glass 1

$\pi(2.5^2)6$

$\pi(6.25)6$

37.5π $37.5(3.14)$ 117.75

117.75 cm^3

b. Glass 2

$\pi(3^2)3$

$\pi(9)3$

27π

$\frac{1}{2}\left(\frac{2}{3}\pi 3^3\right)$

$\frac{2\pi \cdot 27^9}{3_1}$

18π

$27\pi + 18\pi$

45π

$45(3.14)$

141.3

141.3 cm^3

c. Glass 3

$\frac{\pi 3^2(3\sqrt{3})}{3}$ $\frac{\pi 3^3\sqrt{3}}{3}$ $\pi 3^2\sqrt{3}$ $9\sqrt{3}\pi$ $9\sqrt{3}(3.14)$ $28.26\sqrt{3}$

$28.26\sqrt{3}$ cm^3

3. Find the height of liquid in Glass 2 when it is half full. Show your calculations.

3 1/2 cm

18π = volume of hemisphere
22.5π = half of total volume
27π = volume of cylinder
3 = height of cylinder

$22.5\pi - 18\pi$
4.5π

$\frac{4.5\pi}{27\pi}$ $\frac{9\pi}{54\pi}$ $1/6$

$1/6 \cdot 3 = 3/6 = 1/2$

$3 + 1/2 = 3\,1/2$

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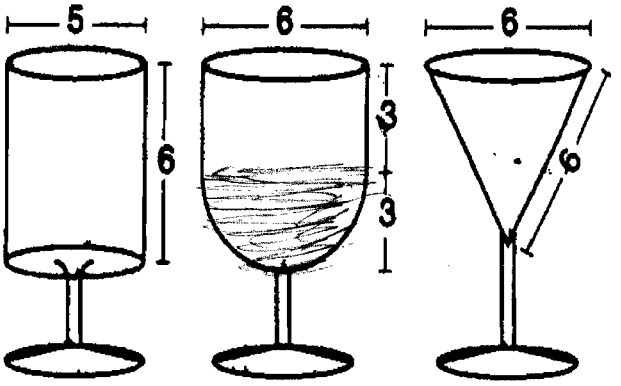

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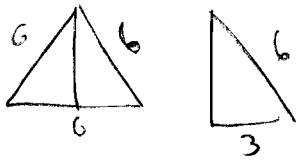


$a^2+b^2=c^2$
$a^2+9=36$
$a^2=27$
$a=\sqrt{27}\approx 5.196$

≈ 5.2 cm.

2. Calculate the volume of the bowl of each of these glasses. Show your work.

a. Glass 1

$\pi r^2 h = \pi(2.5)^2(6) = (6.25)(6)\pi = 37.5\pi$
(≈ 117.75)

≈ 117.75 cm^3

b. Glass 2

$\pi r^2 h = \pi(3)^2(3) = 27\pi$
$\frac{4\pi r^3}{3} \div 2 = \frac{(4)(3^3)\pi}{3} \div 2 = 18\pi$ hemisphere
$27\pi + 18\pi = 45\pi \ (\approx 141.3)$

≈ 141.3 cm^3

c. Glass 3

$\frac{\pi r^2 h}{3} = \frac{\pi(3^2)(5.2)}{3} = 15.6\pi$
(≈ 48.984)

≈ 48.98 cm^3

3. Find the height of liquid in Glass 2 when it is half full. Show your calculations.

Vol. of glass 2: 45π $\frac{45\pi}{2} = 22.5\pi$

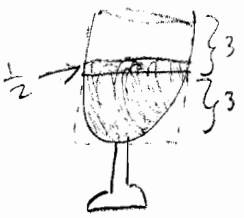
$22.5\pi - 18\pi = 4.5\pi$

↑ vol. of hemisphere

$\frac{27\pi}{3} = \frac{9\pi}{1} = 9\pi$ of liquid per cm

↑ vol. of cylinder

$9\pi - 4.5\pi = 4.5\pi$ (4.5π is half of 9π, so $3 + \frac{1}{2} = 3\frac{1}{2}$)



$3\frac{1}{2}$ cm