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PHYS 1225 Sec. 1
Desk # 9
Nov. 1, 2016

Measuring π

Purpose: Measure the value of π using the volume of spheres of different sizes.

Apparatus: 5 steel spheres (different sizes), Vernier caliper # 9, 2-pan balance # HT14, beaker, stand, magnet.

Data

Diameter and Volume of Spheres

Sphere	Diameter (cm)	Volume (cm^3)
# 1	0.64	0.14
# 2	1.27	1.08
# 3	1.90	3.60
# 4	2.23	5.82
# 5	2.55	8.73
Uncertainty	0.01	0.05

Calculations:

Plan for graphing: $V = \frac{\pi}{6} D^3$

So we will plot D^3 on x-axis, V on y-axis
therefore slope $= \frac{\pi}{6}$, we can calculate $\pi = 6(\text{slope})$

uncertainty $\frac{\delta\pi}{\pi} = \frac{\delta \text{ slope}}{\text{slope}}$

Graphing data:

Sphere #	$x = D^3$ (cm^3)	$\delta x = 3D^2 \delta D$ (cm^3)	$y = V$ (cm^3)	δV (cm^3)
1	0.26214	0.0123	0.14	0.05
2	2.0484	0.0484	1.08	0.05
3	6.859	0.1083	3.60	0.05
4	11.090	0.1492	5.82	0.05
5	16.581	0.1951	8.73	0.05

To find $\delta x = \delta(D^3)$: $\quad x = D^3$

$$\frac{\delta x}{x} = 3\frac{\delta D}{D}$$

so $$\delta x = \frac{3\delta D}{D} \cdot x = \frac{3\delta D}{D} D^3 = 3D^2 \delta D$$

See next page for graph and slope calculation

slope = 0.52602

π = 6 slope = $6 \times 0.52602 = 3.1561$

Uncertainty Analysis

From the graph (next page), δ slope = 0.00076, so

$$\frac{\delta \pi}{\pi} = \frac{\delta \text{ slope}}{\text{slope}} = \frac{0.00076}{0.52602} = 0.0014448$$

$$\delta \pi = \frac{\delta \pi}{\pi} \cdot \pi = 0.0014448 \times 3.1561 = 0.00456 \approx 0.005$$

Conclusion: We found π to be 3.156 ± 0.005 ($\pm 0.14\%$)

Discussions: Our result of π ranges from 3.151 to 3.161, which doesn't agree with the reference value 3.14159..... We ignored the effect of the temperature, which may have changed the density of water so it's not bigger or $1.00\ g/cm^3$.

	x=D^3	δx=3D^2δD	y=V	δV
1	0.26214	0.0123	0.14	0.05
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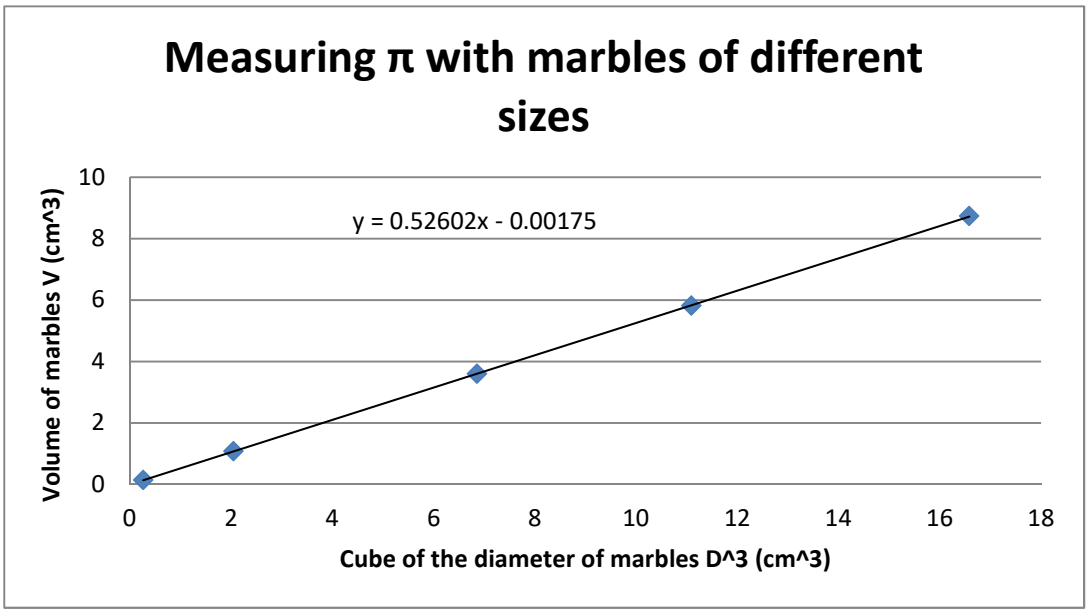
slope:	0.526018	-0.0018
δ slope:	0.000759	0.0072



RAW DATA !

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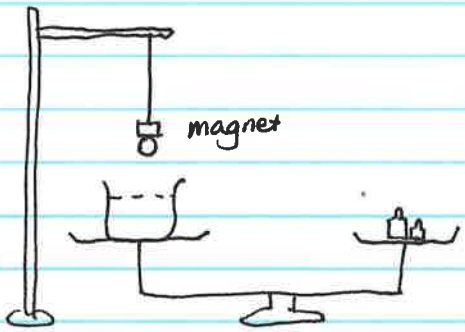
Apparatus: Vernier caliper #9, 2-pan balance #HT14,
5 spheres, — steel, not numbered, diff. sizes
beaker, stand, magnet



Because we used H_2O
$1\ g \leftrightarrow 1\ cm^3$

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	1	0.64	0.14
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	3	~~1.99~~ 1.90	3.60
	4	2.23	5.82
	5	2.55	8.73
		All: ± 0.01	All: ± 0.05

NOV 1