

Connecting Math and Physics with Modeling Exercises

T1A

9:00 – 9:15 am

Robert L Kimball

Physics is a foundation for many applied courses.

- **Activity 1: Density**
- **Activity 2: Archimedes**

Giving Meaning to SLOPE

Two Solids

Heavy



Light



Giving Meaning to SLOPE

Heavy



Light



Compute the **VOLUME** of each solid.

Volume

Parallelepiped

$$V_H = (2 \text{ in.})(.5 \text{ in.})(.5 \text{ in.}) = .5 \text{ cubic inches}$$

$$V_L = (2 \text{ in.})(.5 \text{ in.})(.5 \text{ in.}) = .5 \text{ cubic inches}$$

Cylinder

$$V_H = \pi(.25 \text{ in.})^2(15/8 \text{ in.}) = .37 \text{ cubic inches}$$

$$V_L = \pi(.25 \text{ in.})^2(2 \text{ in.}) = .39 \text{ cubic inches}$$

Volume: Converting to Metric

Parallelepiped

$$V_H = (2 \text{ in.})(.5 \text{ in.})(.5 \text{ in.}) = .5 \text{ cubic inches}$$

$$\left(\frac{.5 \text{ in}^3}{1} \right) \left(\frac{2.54 \text{ cm}}{1 \text{ in}} \right)^3$$
$$= 8.19 \text{ cm}^3$$

Mass



DATA

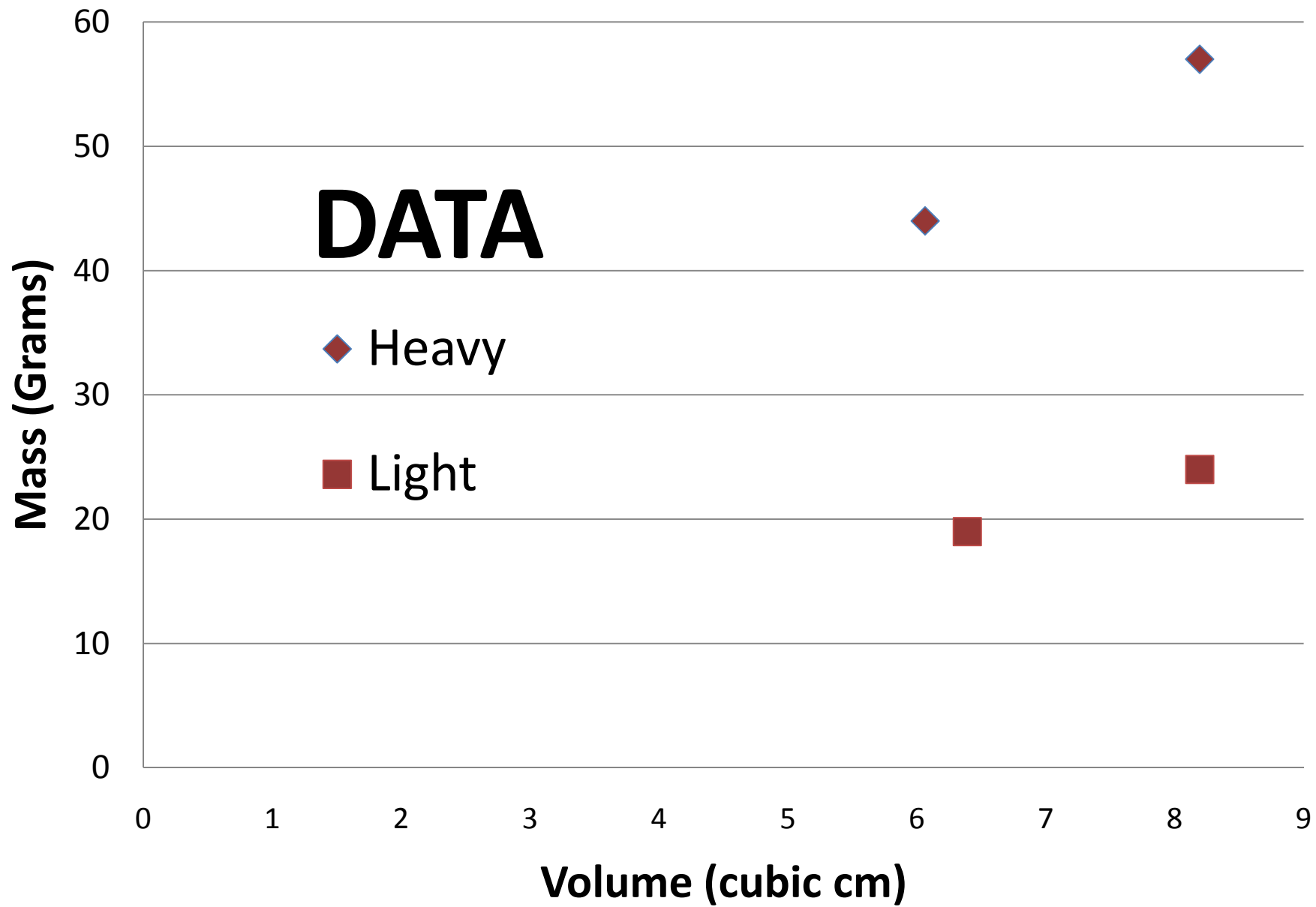
VOLUME

MASS

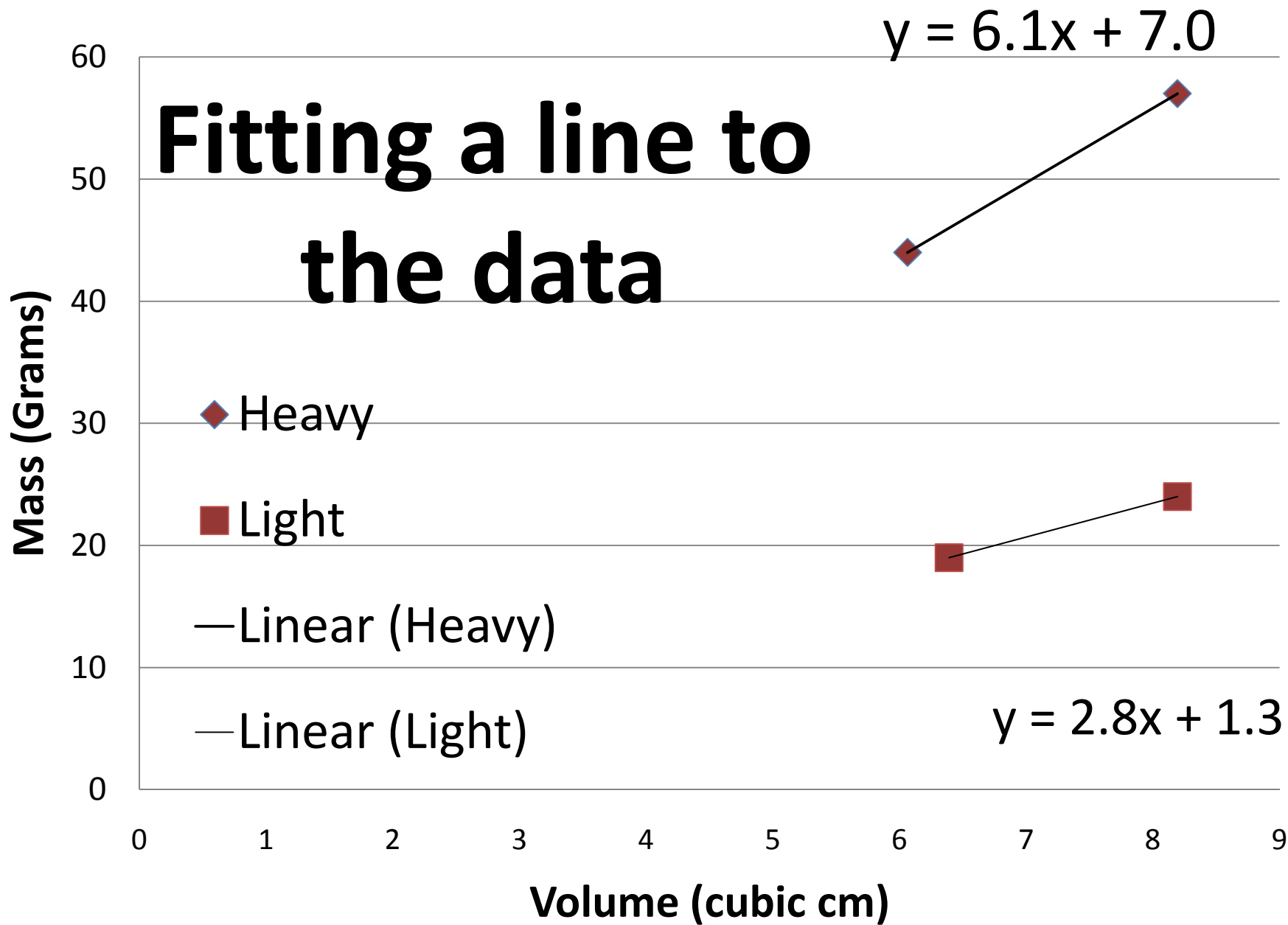
cubic cm

grams

H E A V Y	parallelepiped	8.19	57
	cylinder	6.06	44
L I G H T	parallelepiped	8.19	24
	cylinder	6.39	19



Fitting a line to the data



What is the slope of each trendline?

Heavy

6.1 grams per cubic cm

$$Y = 6.1x + 7$$

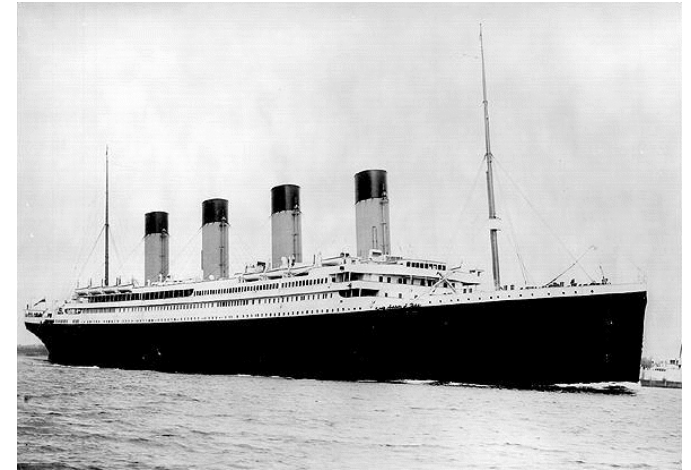
Light

2.8 grams per cubic cm

$$Y = 2.8x + 1.3$$

Archimedes

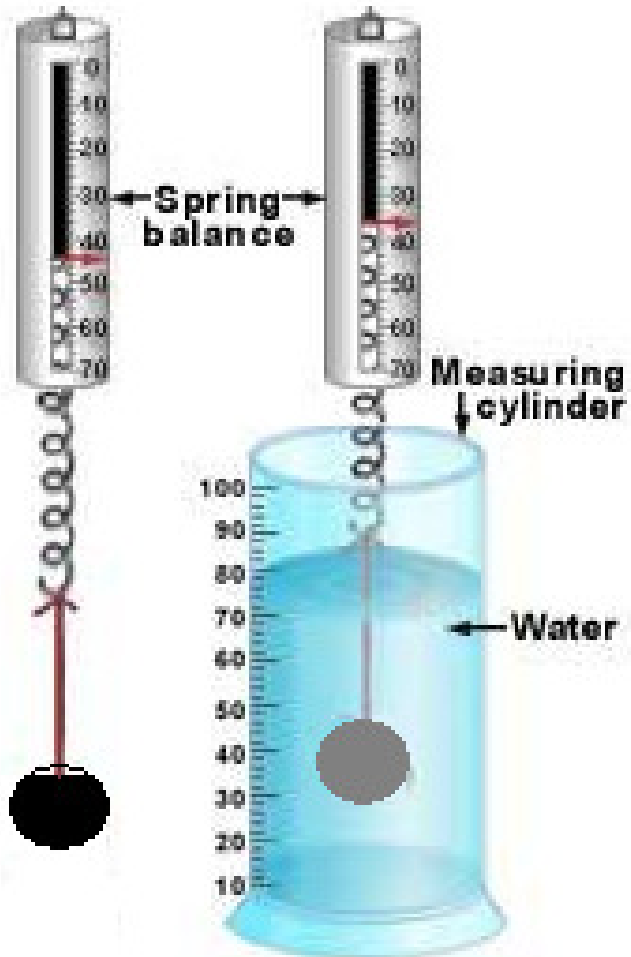
The most famous cruise ship of all time is probably the Titanic. The Titanic was 882' 9" long and 92' 6" wide. Filled with 2,228 passengers and crew, it weighed about 46,000 tons. Have you ever considered how such a huge vessel remains afloat?



Well, obviously it didn't! However, without a hole in its hull, it would still be sailing across the vast ocean.

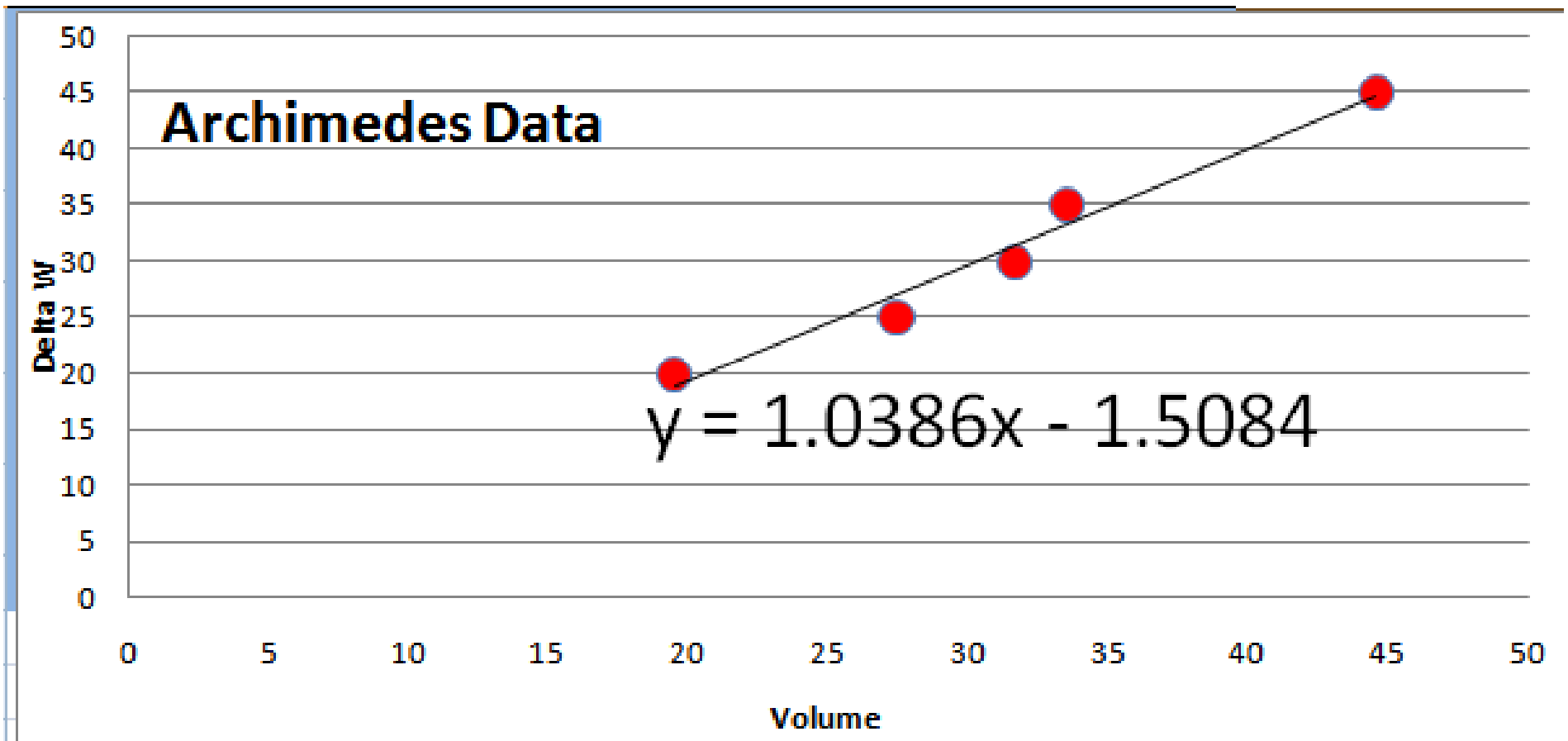
This activity will investigate the property that explains the force that keeps objects like the Titanic afloat.

Data Collection



	A	B	C	D
1	Volume	Weight_{AIR}	Weight_{WATER}	ΔW
2	31.6	270	240	30
3	27.4	250	225	25
4	33.5	285	250	35
5	44.5	325	280	45
6	19.5	200	180	20

Analyze the Data



The slope of the linear model is 1.0386 grams per cubic cm.

Analyze the Data

$$\left(\frac{1.0386 \text{ grams}}{1 \text{ cm}^3}\right) \left(\frac{2.54 \text{ cm}}{1 \text{ in.}}\right)^3 \left(\frac{12 \text{ in.}}{1 \text{ ft.}}\right)^3 \left(\frac{1 \text{ pound}}{453.6 \text{ grams}}\right)$$
$$= 64.8 \text{ pounds per cubic foot}$$

The slope of the linear model is 1.0386 grams per cubic cm which is equivalent to 64.8 pounds per cubic foot ... Which one might recognize as a figure close to the density of water; 62.4 pounds per cubic foot.