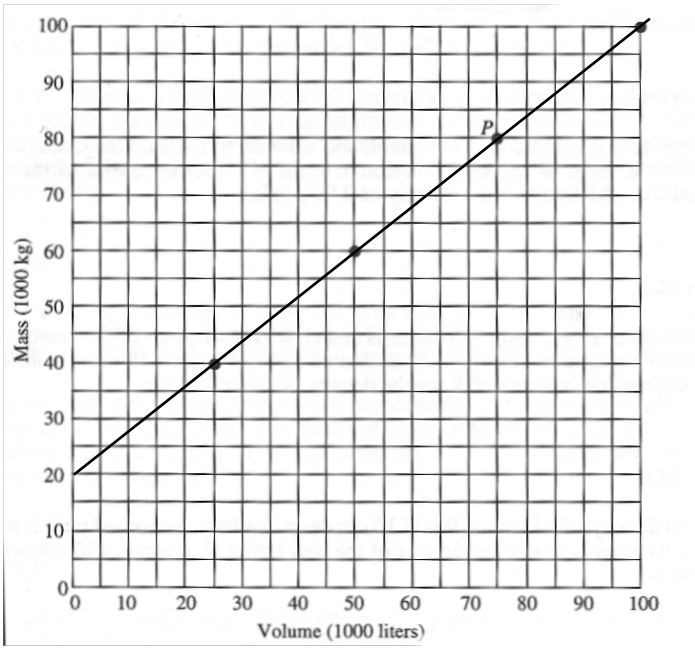
PSC 1121 Celebration of Knowledge 1 Fall 2002 / Dr. Saul

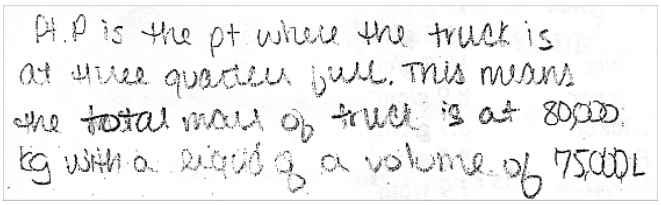
Problem 5 (20 points)

A tank truck is used to haul a certain liquid. The truck has different masses depending on how full the tank is. The trucker is more concerned with the total mass of the truck and load than the mass of the liquid alone. Below is a graph of the mass of the loaded truck versus volume of liquid in the tank. The points represent the tank being one-quarter full, half-full, three-quarters full, and full.



a. What does the single point P tell you?

Student Solution:



Dr. Saul: To receive full credit on part (a.), you needed to indicate that the coordinates of point P told you the mass of the truck + the liquid and the volume of the liquid in the truck and provide the values with units..

b. What is the density of the liquid when the truck is three-quarters full? Explain how you can tell.

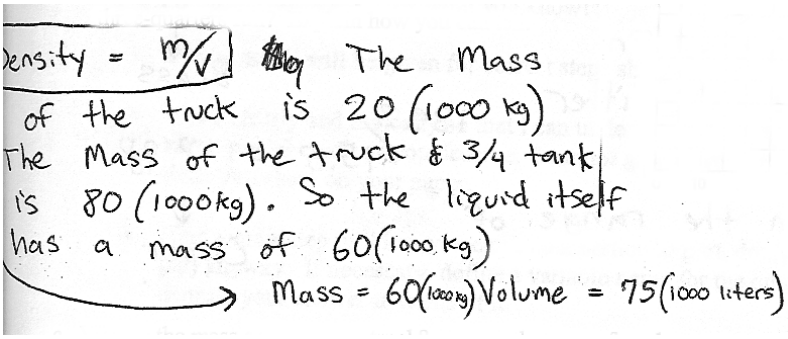
There were two ways to find the answer to part b. One is realize that the Density of an object = the mass of the object / the volume of the object. Using point P,

$$D = \frac{Mass\ of\ Liquid}{Volume\ of\ Liquid} = \frac{M_{truck+liquid} - M_{truck}}{V_{liquid}}$$

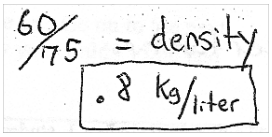
$$\frac{80{,}000kg - 20{,}000kg}{75{,}000l} = \frac{60{,}000kg}{75{,}000l} = 0.80kg/l$$

(See part c on how to determine the mass of just the truck.)

Student Solution:



Thus



This is a good solution except for the tendency to leave the units off of numbers and not label the final answer.

The other way to do this problem is to realize after the initial point with volume = 0, the increase in mass in entirely due to the liquid. Thus the slope of the Mass vs. Volume line shown above is the density of the liquid. Picking the points where the truck is one quarter full of liquid and where the truck is full of liquid:

$$slope = \frac{rise}{run} = \frac{\Delta Mass}{\Delta Volume} = \frac{M_{full} - M_{one\ quarter\ full}}{V_{full} - V_{one\ quarter\ full}} = \frac{100{,}000kg - 40{,}000kg}{100{,}000l - 25{,}000l} = \frac{60{,}000kg}{75{,}000l} = 0.80kg/l$$

density of liquid = slope = 0.80 *kg / l*

Problem 5 (cont.)

c. What is the mass of the empty truck? Explain how you found your answer.

Again, there are two ways to answer this question.

Student solution 1:

Thus, a full tank (4 quarters) of liquid has a mass of 80,000 kg.

Each quarter tank is 20 ~~kg~~ (1000 kg)

The total mass w/a full tank is 100 (1000 kg)

Take away the 80 (1000 kg) of liquid & you are left with 20 (1000 kg) which is the mass of the truck.

Student Solution 2: The line refers to the trendline through the points.

20,000 kg: continue the line until it reaches the y-axis. This # is the weight of the empty truck b/c the the volume is equal to zero where the line touches the y axis

The point where the trend line crosses the vertical (y) axis is the y-intercept. This is the point where the truck is empty and volume and mass of the liquid is zero.