

LABORATORY #4 QUESTIONS

Do not attach this to your homework. I already have a copy of the questions!

For this homework, you will use the temperature-viscosity data provided on the website. This data was collected in our materials lab four years ago using a Brookfield Rotational Viscometer.

1. In Excel, create a temperature-viscosity chart per ASTM D2493 by plotting the log of the log (no, that's not a typo) of the measured viscosities in centipoise on the y-axis and the log of the absolute temperatures in degrees Rankine on the x-axis. (You have to use degrees Rankine because you can't take the log of a temperature below zero in degrees Fahrenheit). **DO NOT USE LOGARITHMIC AXES!** Calculate the logarithms, then plot those values on arithmetic axes.

NOTE: If you use a calculator to calculate the logarithms before plugging them into Excel, be sure to keep at least 3 decimal places (4 significant digits), otherwise you will not get the correct results. Remember, if you know x to 3 significant digits, you know $\log(x)$ to 3 decimal places and vice versa. The temperatures recorded in the lab are accurate to 3 significant digits, so you need 3 decimal places in their logarithms in order to properly represent them.

2. In Excel, fit a linear trendline through the Problem 1 data and record the equation.¹
3. In a future laboratory we will follow ASTM D-6926 "Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus" to make asphalt concrete specimens. In that specification (see §6.2.1) they give (1) a range of viscosities suitable for mixing the asphalt cement with the aggregate and (2) a range of viscosities suitable for compacting the asphalt concrete specimens once they're mixed.

Using the equation from Problem 2, determine (a) the minimum and maximum temperatures for proper mixing and (b) the minimum and maximum temperatures for proper compaction. Express your answers in degrees Fahrenheit, rounded to the nearest degree.

4. Assuming the linear relationship from Problem 2 can be extrapolated to lower temperatures, estimate the viscosity of the asphalt cement at 140°F (which is the temperature at which the absolute viscosity test is run).
5. Based on your answer to Problem 4, what is the most likely viscosity grade of this asphalt cement?

¹ If the equation provided by Excel is $y = ax + b$, then the relationship between viscosity and temperature is

$$\log(\log(\text{viscosity})) = a \log(\text{temperature}) + b$$