SOLUTION-- PROBLEM 9.26

The first step in solving this problem is to use the graph on p. 275 to find the values of log[f N_a (λ/500 nm)] that correspond to the measured equivalent widths.

For the values listed, we get :

$$\log(0.0067/330.238) = -4.69 \text{ for the } 330.298 \text{ nm line}$$
$$\log(0.0560/589.594) = -4.02 \text{ for the } 589.594 \text{ nm line}$$

Next, we use the curve of growth (p. 275) to find the corresponding values on the horizontal axis, and find :

$$\log\left(\frac{f\ N_a\ \lambda}{500\text{ nm}}\right) = 16.63 \text{ for the } 330.298 \text{ line and } 18.55 \text{ for the } 589.594 \text{ nm line.}$$

This step requires some care in accurately reading the values from the axes. Next, since we are given f (oscillator strength) values, we can compute for each wavelength the quantity :

$$\log\left(\frac{f\ \lambda}{500\text{ nm}}\right) = -2.4899 \text{ for the } 330.293 \text{ line and } -0.4165 \text{ for the } 589.594 \text{ line.}$$

and using the properties of logs we can then write :

$$\log N_a = \log\left(\frac{f\ N_a\ \lambda}{500\text{ nm}}\right) - \log\left(\frac{f\ \lambda}{500\text{ nm}}\right)$$

For the 330.298 nm line we get :

$$\log N_a = 16.63 - (-2.49) = 19.12$$

and for the 589.594 line we get :

$$\log N_a = 18.55 - (-0.42) = 18.97$$

These two values average to 19.04, so the column density of sodium determined by this method is $10^{19.04}$ = 1.10 x10^{19} atom / m^2.

The two lines used in the book gave an average of log N_a=18.96, so the average of all four lines is 19.00. If you use this value for the four lines studied (in the text and in this problem), you will see they all fall on the curve of growth if you plot them carefully on Fig. 9.22.