9.17) NEAR THE SURFACE OF AN A2 STAR SUCH AS ALFECCA (α CBr) FOR EACH H ATOM IN THE $n=2$ STATE FOR EVERY 10 MILLION IN THE GROUND STATE. ASSUME M-B STATISTICS ARE VALID TO FIND THE TEMPERATURE.

USING THE M-B ENERGY DISTRIBUTION [9.27 & 9.28] AS IN EXAMPLE 9.6 GIVES

$$\frac{n(E_2)}{n(E_1)} = \frac{g(E_2)}{g(E_1)} e^{\beta(\bar{E}_1 - \bar{E}_2)} \qquad p\ 315$$

FOR THE FIRST TWO STATES OF HYDROGEN

$n=1 = 1s \Rightarrow g(E_1) = 2, \quad \bar{E}_1 = -13.6\,eV$

$n=2 = 2s+2p \Rightarrow g(E_2) = 8, \quad \bar{E}_2 = -3.40\,eV$

$\Big\} \bar{E}_1 - \bar{E}_2 = -10.2\,eV$

THUS

$$e^{(\bar{E}_1 - \bar{E}_2)/kT} = \frac{n(E_2)\,g(E_1)}{n(E_1)\,g(E_2)} = \frac{(1)(2)}{(10\times10^6)(8)} = 2.5\times10^{-8}$$

AND

$$\frac{\bar{E}_1 - \bar{E}_2}{kT} = \ln(2.5\times10^{-8})$$

$$\Rightarrow \quad T = \frac{\bar{E}_1 - \bar{E}_2}{k}\left[\ln(2.5\times10^{-8})\right]^{-1}$$

$$= \frac{-10.2}{8.62\times10^{-5}}\left(\frac{1}{-17.50}\right)$$

$$\boxed{T_{\alpha CBr} = 6{,}761\ K}$$

WOW! WE CAN MEASURE THE TEMPERATURES WITH SPECTROGRAPHS!

¡SHAZAM!