14.20

Stoichiometry $H_2 \rightleftharpoons 2H$

Process $1H_2 + \emptyset H \rightarrow (1-\alpha)H_2 + 2\alpha H$

Equilibrium Constant

$$K(T) = \frac{y_C^{\nu_C} y_D^{\nu_D}}{y_A^{\nu_A} y_B^{\nu_B}} \left(\frac{P}{P_{ref}}\right)^{\nu_C+\nu_D-\nu_A-\nu_B}$$

$$K(T) = \frac{y_H^2}{y_{H_2}} \left(\frac{P}{P_{ref}}\right)^{2-1}$$

$$n_{TOT} = 1-\alpha+2\alpha = 1+\alpha \Rightarrow y_H = \frac{2\alpha}{1+\alpha}$$

$$y_{H_2} = \frac{1-\alpha}{1+\alpha}$$

$$K(T) = \frac{\left(\frac{2\alpha}{1+\alpha}\right)^2}{\frac{1-\alpha}{1+\alpha}} \left(\frac{10\,atm}{1\,atm}\right)^1 = 10\,\frac{4\alpha^2}{(1+\alpha)(1-\alpha)}$$

$$\alpha = 0.09$$

$\therefore K(T) = 0.327 \Rightarrow \log_{10} K(T) = -0.486$

interpolating $\Rightarrow$ Table A-27 gives $\boxed{T = 3488K}$

For greater dissociation, α is larger, and $\log_{10} K(T)$ becomes less negative. Hence T must be larger.