Ex. 6.8(a)(7th) Ex. 4.5(a)(8th) CLARIFICATION

you are given

$$\log(p/\text{Torr}) = 7.960 - \frac{1780}{(T/K)}$$

→ note that the variables are divided by the units associated with them, because the log must be dimensionless (i.e., no units)

so, where does this equation come from?

$$\frac{dp}{dT} = \frac{\Delta_{vap}S}{\Delta_{vap}V} = \frac{\Delta_{vap}H}{T\Delta_{vap}V}$$, and, since $V_m(g) >> V_m(\ell)$
$\Delta_{vap}V \approx V_m(g)$

$$\frac{dp}{dT} = \frac{\Delta_{vap}H}{TV_m(g)} = \frac{\Delta_{vap}H}{T(RT/p)}$$

now, isolate p's & T's on opposite sides of the eqn

$$\frac{dp}{p} = \frac{\Delta_{vap}H}{RT^2}dT$$

note that $d\ln p = \frac{dp}{p}$

$$d\ln p = \frac{\Delta_{vap}H}{RT^2}dT$$

now, you are set to integrate, but do so without limits

$$\ln p = \int \frac{\Delta_{vap}H}{RT^2}dT = \frac{\Delta_{vap}H}{R}\int \frac{1}{T^2}dT$$

$$\ln p = -\frac{\Delta_{vap}H}{RT} + \text{constant}$$

- now this equation resembles the one you were given, except it is ln instead of log. Recall that

$$\frac{\ln x}{\log x} = 2.302585\ldots = 2.303$$

(i) so, $\ln x = 2.303 \log x$

thus: $$\ln(p/\text{Torr}) = 18.33 - \frac{4099}{(T/K)}$$

and $\frac{d\ln p}{} = \frac{4098}{\cancel{T^2}} = \frac{\Delta_{vap}H}{R\cancel{T^2}}$

$\Delta_{vap}H = (4098)(8.314\ J\ K^{-1}mol^{-1}) = \boxed{34.07\ kJ\ mol^{-1}}$

(ii) Find Tb : $\log(760) = 7.960 - \frac{1780}{(T/K)}$ $T = T_b$

$(T_b/K) = \frac{-1780}{\log(760) - 7.960} = 350.4$ so $\boxed{T_b = 350.4K}$