

Pop Quiz 1, Chemistry 481, 30 Aug 2019

Consider the derivative

$$\frac{d}{dT} \exp[-f(T)]$$

1. What are the units of $f(T)$? (2 pts) . Anything in the argument of an exponential can not have dimensions. Dimensionless

2. Obtain an expression for the derivative $\frac{d}{dT} \exp[-f(T)]$ (3 pts) If f is a function of y and y is a function of x , then $df(y)/dx = df[y(x)]/dx = df/dy \times dy/dx$. In the present case this gives

$$\frac{d}{dT} \exp[-f(T)] = \exp[-f(T)] \times d[-f(T)]dT = -\exp[-f(T)] \frac{df(T)}{dT}$$

.

3. Suppose that $f(T) = E/k_B T$, where E and k_B are constants. Obtain an expression for the temperature at which $\exp[-f(T)] = 1/2$. (5 pts) We need to solve $\exp[-f(T)] = 1/2$. Taking the natural log of both sides gives $-f(T) = \ln 1/2$. But $f(T) = E/k_B T$, so $-E/k_B T = \ln 1/2$. Solving for T gives, finally, $T = -E/(k_B \ln 1/2)$. This is the correct answer, but it can be simplified a bit using $\ln 1/2 = -\ln 2$. This gives $T = E/(k_B \ln 2)$.