

### DFRSOFT EXAMPLE 2 Determining the Activation Energy

The MTTFs at +250°C and +200°C are 731 and 10,400 hours, respectively, in Figure 6.8. Show that the activation energy is 1.13 eV and that the MTTF at +125°C is  $1.95 \times 10^6$  hours as indicated in the figure.

**SOLUTION:** Equation 9.4 can be solved for  $E_a$  as

$$E_a = K_B \frac{\text{Ln}\{MTTF_2 / MTTF_1\}}{(1/T_2 - 1/T_1)} \quad (9.6)$$

Then, the activation energy is

$$E_a = 8.6173 \times 10^{-5} \text{ eV/}^\circ\text{K} \frac{\text{Ln}[10400/731]}{[1/(273.16+200) - 1/(273.16+250)] \text{ }^\circ\text{K}} = 1.133 \text{ eV}$$

Next, the acceleration factor at +125°C must be determined. Using the procedure in Example 9.1, we have

$$T_{\text{use}} = +125^\circ\text{C}$$

$$T_{\text{Stress}} = +200^\circ\text{C}$$

$$A_T = \text{Exp}\{(1.133 \text{ eV}/8.6171 \times 10^{-5} \text{ eV/}^\circ\text{K}) \times [1/(273.15+125) - 1/(273.15+200) \text{ }^\circ\text{K}]\} = 187.6$$

From Equation 9.1, the MTTF (at +125°C) = MTTF (at +200°C)  $\times A_T = 10400 \times 187.7 = 1.951 \times 10^6$  hours. The answer is a bit off to the value shown in Fig. 6.8, due to round-off error.

### Enter numbers in A99 Area on Acceleration Factor Work Sheet

Enter 3-20 numbers  
in Green Area

Read Activation  
Energy

ARRHENIUS LEAST SQUARES FIT ANALYSIS FOR ACTIVATION ENERGY OF 2 TO 20 POINTS					
Comment	ENTER Temperature	Failure Times MTTF	Results Least Sq Fit (MTTF)	MTTF Extrapolation 1 Temperature At 200 C	Results Activation Ea Intercept D and K1
3 to 20 parameter least squares fit	200	10400	10416.18348	10400	Activation Energy (eV)
Make sure any extra temperature cells are left blank.	250	731	731.3513018	10411.18011	
	250	731	731.3513018	10411.18011	
					1.133119052
					D
					-18.54093542
					K1 is
					1.1278E+08
					Cor. Coef
					1
					B= Ea/Kb
					12998.95666
					C=1/K1
					8.8669E-09
					to=exp(D)
					1
Extrapolation Result of Least Sq. Fit Above	ENTER Temperature Deg C		MTTF Extrapolation 1 Temperature At 200 C	MTTF Extrapolation Temperature At 125 C	
Extrap Temperature 1	200		1.0400E+04	1.9520E+06	
Extrap Temperature 2	125				

**EXAMPLE**

MTBF Extrapolations Any Temperature

### Arrhenius Least Squares Fit to data Results Cell A133 Area on Acceleration Factor Sheet

