GLY 4310 Name KEY
Homework Exercise 4

EQUILIBRIUM CONSTANT

The equilibrium constant for a reaction can be roughly formulated as follows:

$$K = e^{-\frac{E}{RT}} \tag{1}$$

where E = energy barrier (calories/mole)

R = gas constant = 1.987 cal/° mole

T = temperature (Kelvin)

°C + 273.15 = Kelvin

e = natural logarithm base

1. Suppose a reaction takes place at a constant temperature of 0°C. Calculate K for the following values of E.

E, cal/mol	K
5.0	0.99(1)
50.	0.91(2)
500.	0.40 (0.398)
5000.	1.0×10^{-4} (9.98×10^{-5})
50000.	9.8×10^{-41}

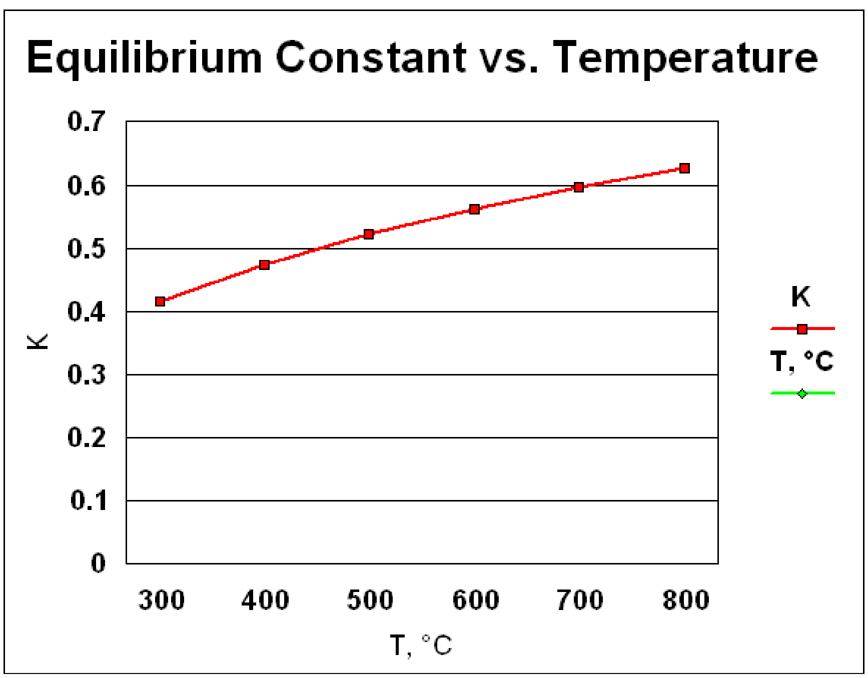
Assume all values of E are good to two significant figures.

2. Suppose a reaction takes place with a constant energy barrier of 1000 cal/mol. Calculate K for the following temperatures.

T, °C	K
300	0.416 (0.4156)
400	0.474 (0.4735)
500	0.522 (0.5216)
600	0.562 (0.5612)
700	0.596 (0.5962)
800	0.626 (0.6257)

Assume T and E values are good to three significant figures.

3. Prepare a plot of K vs. T for the temperature range 300 to 800°C. This may be done on a computer, but the plot must be printed out and handed in.



4. For a constant energy barrier of 1000 cal/mol calculate the temperature in °C at which the amount of products should equal the amount of reactants
(i.e. when K = 0.500). This answer should be calculated to three significant figures. (HINT: Take the natural log of both sides of the above equation).

T = __453__________ °C

$$\ln K = \ln e^{-\frac{E}{RT}} = -\frac{E}{RT} \tag{2}$$

$$\ln 0.5 = -\frac{1000}{1.987 \cdot T} \tag{3}$$

$$T = -\frac{1000}{1.987 \cdot \ln 0.5} = -\frac{1000}{-1.377} = 726.1\ K \tag{4}$$

$$T\,(°C) = 726.1 - 273.2 = 453\ °C \tag{5}$$