**Chem Review: A Set of Offbeat and Easier Questions for 2013 (for solutions, see June exam center on web site)**

1. For each of the following reactions:
   (1) Give the number of steps in each reaction. (each step has its own activation energy)
   (2) Find the value of the highest activation energy.
   (3) Out of the two or three steps that each reaction has, which is most likely to be the slowest?
   (4) Is the overall reaction exothermic? What is the overall ΔH?

a)

Progression de la réaction
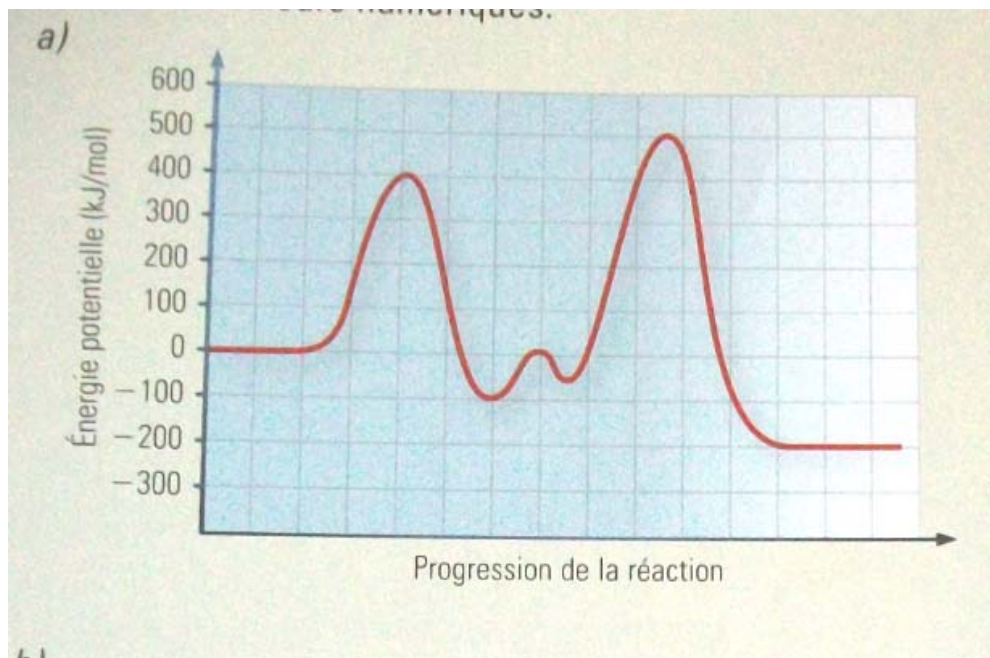
(1) 3 steps
(2) A_e= 500-(-50) = 550 kJ (sig figs: when subtracting(or adding) only, you apply the decimal rule)
(3) Step number 3(the one with the highest activation energy)
(4) Exo: $\Delta H = H_{final} - H_{initial}$ = -200 – 0 = -200 kJ

b)

Énergie potentielle (kJ/mol)

Progression de la réaction
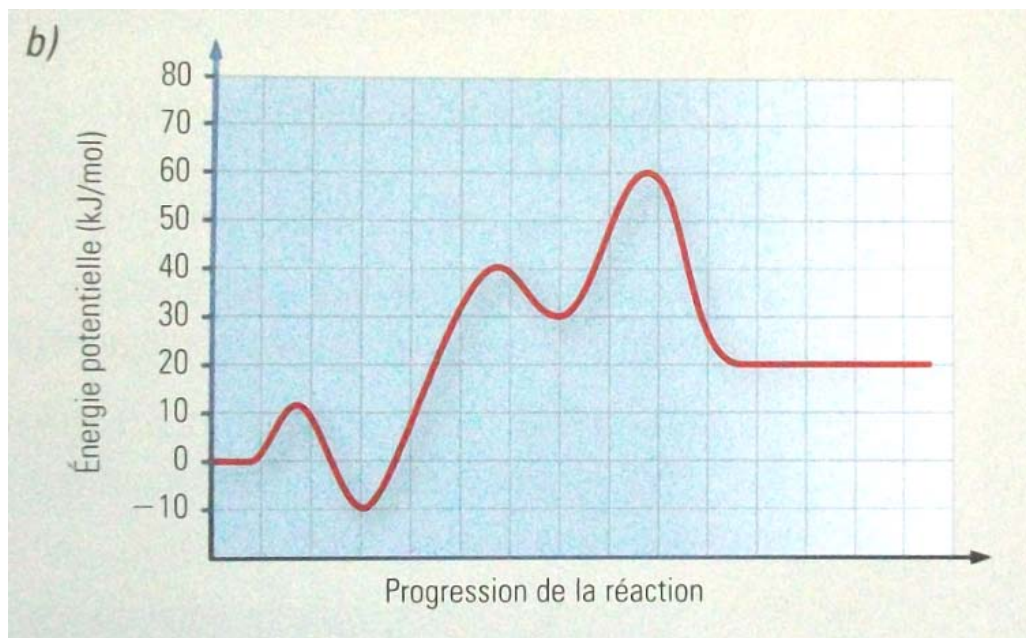
(1) 3 steps
(2) A_e= 40 –(-10) = 50 kJ (sig figs: when subtracting(or adding) only, you apply the decimal rule)
(3) Step number 2 (the one with the highest activation energy)
(4) Endothermic: ΔH = 20 – 0 = 20 kJ

c)

Énergie potentielle (kJ/mol)

Progression de la réaction
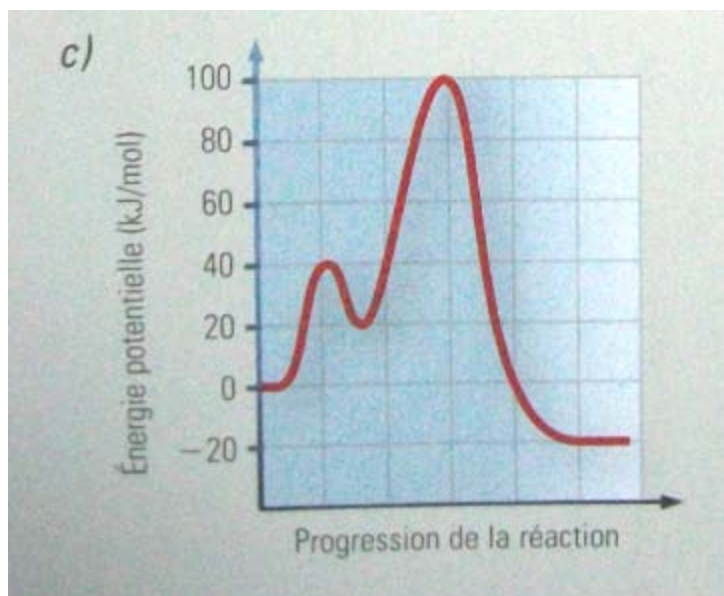
(1) 2 steps
(2) A_e= 100 –20 = 80 kJ (sig figs: when subtracting(or adding) only, you apply the decimal rule)
(3) Step number 2 (the one with the highest activation energy)
(4) Exothermic: ΔH = -20 – 0 = -20 kJ

2.   The May 6th 2013 edition of the Economist ran an interesting story about the American chestnut which was almost wiped out in the 20th century. A fungus infecting Chinese chestnuts spread to indigenous trees, killing almost 2 billion of them.

The story goes on to report about how a combination of hybridization and genetic engineering may allow the American chestnut to make a comeback.

The fungus kills because it secretes oxalic acid.

Oxalic (1)	$H_2C_2O_4$	Oxalate ion $HC_2O_4^-$	$K_A = 5.9 \times 10^{-2}$

a) Write an equation and calculate the pH of a 1.0 M solution of $H_2C_2O_4$

|	$H_2C_2O_4$ =	H^+ +	$HC_2O_4^-$
I	1.0	0	0
C	x	x	x
E	1.0 - x	x	x

$x^2/(1.0 - x) = 5.9 \times 10^{-2}$

$x^2 = 5.9 \times 10^{-2}\,(1-x)$

$x^2 + 5.9 \times 10^{-2}\,x - 5.9 \times 10^{-2} = 0.$

$x = .2151839799\ M = [H^+]$

$pH = -\log [H^+] = -\log [.2151839799] = 0.67$

b) Biologists have isolated a gene from wheat which produces and enzyme than then converts oxalate to carbon dioxide.

Show a distribution of kinetic energies for the breakdown of oxalate with and without the enzyme. (note-- the enzyme is a catalyst)

A_v with catalyst

\# of molecules

E_R
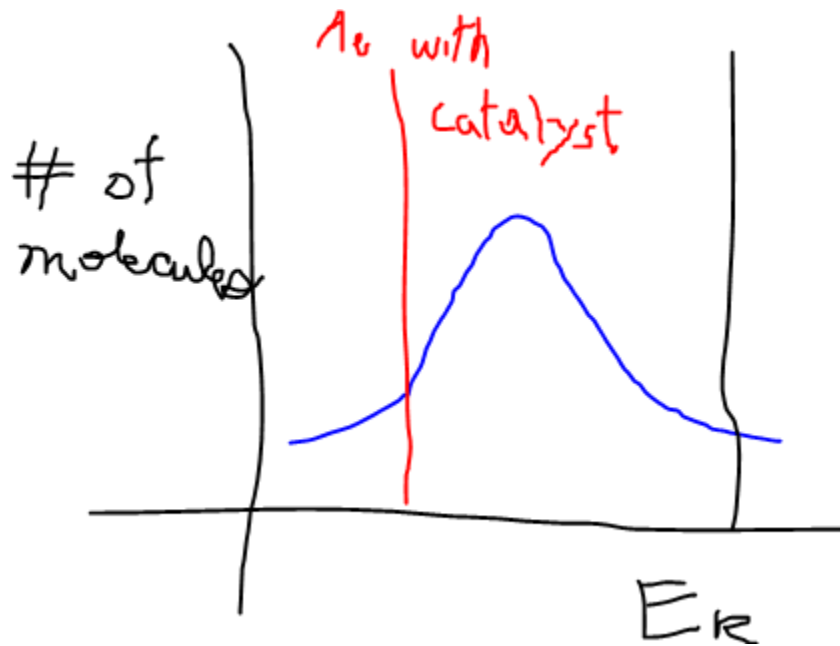
c) They have also incorporated the oxalate gene into a plasmid and have fooled the American chestnut into incorporating the gene into its own DNA.

What will the chestnut start doing? How will this help it survive the fungus?

With the enzyme(catalyst)the chestnut will start breaking down the acid produced by the fungus and have a better chance of surviving the disease.

d) By the way, is the conversion of $HC_2O_4^-$ to CO_2 an oxidation? Show why or why not.

2C + 1+(-2)(4) = -1

C = 6 in $HC_2O_4^-$

But in CO_2, C = 4, so it's a reduction.

e) If another acid has a K_A of 5.1 X 10^{-3}, how does its strength compare to that of oxalic acid?

Since this other acid has a lower K_A, it is considered a weaker acid.

f) Why can't pH be used to compare the relative strengths of two different acids?

The initial concentration will affect pH, so a weak acid with a very high initial concentration can end up with the same pH as a stronger acid that's prepared with a lot more water. K_A takes both initial concentration and pH into account, so it's the better way of comparing acidic strength.

3. a) How many grams of $Tl(OH)_3$ will you find in 50.0 ml of a saturated solution? Its Ksp is a whoppingly-low 1.68 X 10^{-44}.

4.

	$Tl(OH)_3$ =	Tl^{+3} +	3 OH$^-$
I		0	0
C	x= solubility in mol/L	x	3x
E		x	3x

Ksp = $[Tl^{+3}] [OH^-]^3$ = $x(3x)^3$ = 1.68 X 10^{-44}.

$27x^4$ = 1.68 X 10^{-44}.

X = 4.99 X 10^{-12}M =

In 50.0 ml there will be: 4.99 X 10^{-12} mol/L *0050 L *255.4 g/mole = 6.38 X10^{-11} g.   (3 SF)

b) What effect will the addition of acid have on the above equilibrium?

It will discourage the reverse reaction by consuming base, so there will be more Tl^{+3} produced. The solubility of $Tl(OH)_3$ will increase.