Chemistry 225 Semester 04-2016
Homework for Submission #2

Answer the following questions and submit them for as instructed. Only answers showing full working may attract full marks. Careless and sloppy work will be penalised. Express your answers to the correct number of significant figures. Make sure you include correct units where appropriate. *Answers showing evidence of copying will attract zero marks.*

1) Lactate, ($CH_3CH(OH)COO^-$) is oxidised to pyruvate (CH_3COCOO^-) in the presence of a suitable enzyme. The following table gives the concentration of lactate at various times.

t/s	0	100	250	350	500	650
[lactate]/M	3.200×10^{-2}	2.724×10^{-2}	2.138×10^{-2}	1.821×10^{-2}	1.429×10^{-2}	1.122×10^{-2}

Use a spread-sheet program to plot the natural logarithm of the concentration of lactate against time and hence (a) suggest the order of reaction with respect to lactate giving your reasoning, and (b) on this basis determine the rate constant for the reaction. (Submit your graph and full working.)

c) Calculate the half-life for the reaction.

d) Calculate the fraction of the original lactate remaining after 3 half-life periods from the start of the reaction.

e) Calculate the time taken for 10% of the lactate to decompose.

2) The half-life of carbon-14 is 5600 years. It gradually decays into nitrogen-14 by a first-order process, and each atomic disintegration gives rise to a β-particle which may be counted by a suitable counter. The number of disintegrations per minute (cpm) as recorded by such a counter is proportional to the concentration of carbon-14 in a sample of wood. The wood from an Egyptian mummy case gives a reading of 9.5 cpm as compared with a fresh sample of wood which gives 15.0 cpm. Calculate the age of the case.

3) The anti-cancer drug cisplatin, $Pt(NH_3)_2Cl_2$, is hydrolysed in aqueous solution according to the equation:

$$Pt(NH_3)_2Cl_2(aq) + H_2O(l) \rightarrow Pt(NH_3)_2(H_2O)Cl^+(aq) + Cl^-(aq)$$

The rate of the reaction increases by a factor of 15 on increasing the temperature from 25°C to 50°C. Estimate the activation energy for the reaction in kJ mol^{-1}.

4) The reaction

$$A + B \rightarrow C + D$$

has the rate law:

$$\text{Rate} = k[A][B]$$

A student proposes the following mechanism:

i. $A + B \rightarrow AB$ … fast
ii. $AB \rightarrow A + B$ … fast
iii. $AB + D \rightarrow CD + D$ … slow
iv. $CD \rightarrow C + D$ … fast

The rate constants for the successive steps may be called k_i, k_{ii}, k_{iii}, and k_{iv}.

a) Determine the overall reaction suggested by the mechanism.

b) Derive the rate law suggested by the mechanism.

c) Identify a catalyst.

d) Identify a reactive intermediate.

e) Explain why the suggested mechanism is incorrect.