

Mini Mock Exam

CHE-2C2Y COURSE TEST 2

Name: _____

There are five little random questions in this booklet from the entire course.

Read through the question carefully and answer in full.

No cheating!

Question	Maximum Mark (%)	Your Mark (%)
1	20	
2	20	
3	20	
4	20	
5	20	
	Total Percentage	

Question 1

Thermodynamics I

1. Calculate ΔS , ΔS_{surr} and ΔS_{tot} for:

(a) the isothermal, reversible expansion

(b) the isothermal, free expansion

of one mole of ideal gas molecules from 8.00 L to 20.00 L and 292 K.

Explain any differences between the two paths.

[20%]

Question 2

Thermodynamics 2

2. a. Draw a pressure – temperature phase diagram for a single component mixture ensuring that you show any phase boundaries and label the triple point, critical point, and region of supercritical fluid.

[10%]

b. At 276 K the osmotic pressure of a protein solution is 172 N m^{-2} . The concentration is 1 g in 200 cm^3 of solution. Assuming ideal behaviour calculate:

i. the concentration of the protein in mol m^{-3}

[5%]

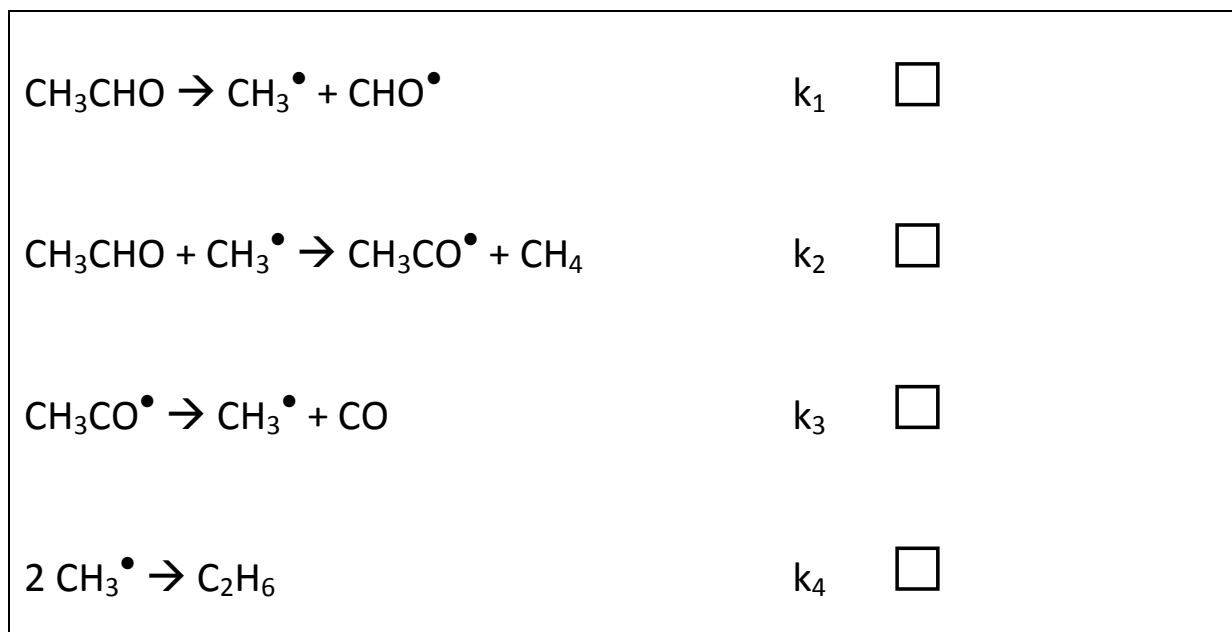
ii. the molar mass of the protein in g mol^{-1}

[5%]

Question 3

Complex Kinetics

3. The following Rice-Herzfeld mechanism is shown:



a. Label which reaction steps are Initiation, Propagation and Termination steps by placing I, P or T respectively in the boxes.

[5%]

b. Apply a suitable approximation to show that the rate of formation of methane can be expressed as:

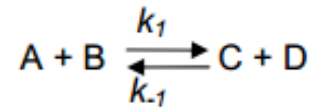
$$\frac{d[\text{CH}_4]}{dt} = k_2 \sqrt{\frac{k_1}{2k_4}} [\text{CH}_3\text{CHO}]^{3/2}$$

[15%]

Question 4

Theories of Chemical Reactions

4. a. In a temperature jump the relaxation time, τ , is measured. Show that for the reaction



the relaxation time is given by

$$\frac{1}{\tau} = \{k_1([\bar{A}] + [\bar{B}]) + k_{-1}([\bar{C}] + [\bar{D}])\}$$

[10%]

b. For an ion combination reaction, $A^+ + B^- \rightarrow AB$, calculate d_{eff} with a dielectric constant of 80.

$$d_{AB} = 4 \times 10^{-10} \text{ m}, e = 1.6 \times 10^{-19} \text{ C}, \epsilon_0 = 8.85 \times 10^{-12} \text{ J}^{-1} \text{ C}^2 \text{ m}^{-1},$$

$$k_B = 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ mol}^{-1}, T = 300 \text{ K}$$

[10%]

Question 5

Surface Chemistry

5. a. When contained in the cylindrical pores of a porous material the vapour pressure of CO₂ drops from the normal vapour pressure at 25 °C of 64.0 bar to a lower value of 62.0 bar. Estimate the pore size of the porous material.

Take the molar volume of CO₂ at 25 °C to be 61.6 cm³ mol⁻¹ and the surface tension to be 1.16 mN m⁻¹, R = 8.314 J K⁻¹ mol⁻¹.

[15%]

b. The chemisorption of a gas is described by the Langmuir isotherm with $K = 8.5 \times 10^{-4} \text{ Pa}^{-1}$. What gas pressure would be required to obtain a surface coverage of 0.5?

[5%]

END OF PAPER